The Dock and Harbour Authority

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Editorial Comments

Coast Erosion.

Making a departure from our customary procedure of commencing each monthly issue of the Journal with a descriptive port article, we are giving the place of honour this month to a subject which we feel is deserving of a good deal more consideration than it has received in the past. Coast Erosion is a process of such gradual and continuous operation that it fails to arrest attention by the very normality of its action, despite the serious and even disastrous nature of its cumulative consequences.

The coastline, in fact, is everywhere the scene of incessant change; both erosion and its counterpart, accretion, have been in evidence since the dawn of history. But within the relatively narrow limits of this island realm, the effects are more clearly marked than elsewhere and can be readily seen in the encroachment of the seas on the soft cliffs and friable foreshores of the East Coast, as well as in the rapid accumulation of sand and shingle in other places.

> ". . . I have seen the hungry ocean gain
> Advantage on the kingdom of the shore,
> And the firm soil win of the wat'ry main,
> Increasing store with loss, and loss with store;"

wrote Shakespeare in Sonnet LXIV some three and a half centuries ago; but the action had been going on for long ages before his time, as it has been continuous right down to the present day.

We feel it opportune to emphasise the fact that the depredations of the sea are as serious as they are obvious. In the interesting and informative Paper which is reproduced in succeeding pages, Mr. T. B. Keay points out that entire towns and villages have disappeared beneath the waves, and that since the time of the Roman Invasion, the sea must have advanced 3 miles inland along the Holderness Coast of Yorkshire. Frequently, there can be seen in the daily press, accounts of heavy falls of cliff, particularly on the South-east Coast. As recently as 1937, there was a fall of about half a million tons of earth at the Warren, Folkestone, while in December, 1934, the collapse took place of something like a quarter of a million tons of chalk at St. Margaret's Bay, Kent, and in the previous year there had been a landslide involving 100,000 tons of cliff at Sidestrand in Norfolk. These are outstanding incidents; many minor occurrences have not been of sufficient importance to be recorded in the press.

Losses such as these, however, whether of a major or minor character, occurring frequently over a lengthy period, are attended by serious territorial depletion. It is little satisfaction to point to instances of deposit and accretion in other districts. Dungeness, it is true, gains thousands of tons of shingle annually and Southport in Lancashire is now blockaded with wide stretches of sand, but such infertile accumulations do not compensate for the loss of valuable arable and agricultural land on the East Coast and elsewhere.

Appealing more nearly to the harbour engineer is the fact that both processes impede his operations and interfere with port works—accretion by the silting up of harbour approaches and river entrances, and erosion by the undermining of harbour protective works. On both these points, the harbour of Madras furnishes a useful illustration, as demonstrated by evidence in the issue of this Journal for May last.

Since the Royal Commission of 1906, nothing has been done by way of investigation or remedial measures, and the Central Sea Defence Authority, recommended in the Report of the Commission, has never been constituted. No doubt, the present moment is hardly opportune for action in this direction, but we certainly think that the matter is one which calls for early attention as soon as possible after the conclusion of hostilities with the Axis powers. The national indifference to the deterioration of its coast line, with all the attendant inimical consequences to both agriculture and navigation, is not creditable to the foresight and business acumen of a people who, in other directions, are capable of energetic and sagacious action.

The Port of Hong Kong and its Future.

During the closing days of August, the report by the late Sir David Owen on the future administration of the Port of Hong Kong was made available to the public of this couuntry. It will be recalled that we announced in our issue of August last year that Sir David had accepted an invitation extended to him by the Government of Hong Kong, through the Colonial Office, to visit the Colony for the purpose of advising upon the future administration of the Port. Some time unavoidably elapsed before his arrival in China, which did not take place until January 10th of this year. The investigation into the conditions prevailing at the present time, in which Sir David had the advice on engineering matters of Mr. Duncan Kennedy, M.Inst.C.E., lasted well into February, on the 24th of which month the report was completed and placed in the hands of the Governor, Sir Geoffry A. S. Northcote, K.C.M.G.

Sir David's conclusions and recommendations are set out in a document of 27 pages, with a plan of the port, which we hope in due course to be able to present to our readers. The current issue does not provide a suitable opportunity of going into the subject in full detail, nor are we in a position as yet to comment effectively on proposals which are fraught with important consequences to the port and its future welfare.

Briefly, however, it may be stated that after weighing each of three courses, which in Sir David's view were alone open to consideration, viz., (a) To allow matters to remain as they are; (b) to adopt some improved method of Government control; and (c) to establish control by some form of Port Authority or Trust, he decided that the third course would be to the advantage of all persons and interests dependent on the Port, and accordingly, recommended the establishment at the earliest possible moment of a Body to be called the Hong Kong Harbour Trust, the constitution of which should be as follows: (a) Three Government officials of high standing, to be appointed by the Governor; (b) three British subjects connected with the trade of the Port, to be appointed by the Governor on the nomination of the General Chamber of Commerce; (c) one person interested in the trade of the Port, to be appointed by the Governor on the nomination of the Chinese Chamber of Commerce; and (d) one independent person of business experience and, if possible, with a knowledge of Port affairs, to be appointed as Chairman by the Governor, on the nomination of the other members of the Trust at a meeting duly held for the purpose.

As stated above, we will reserve comment on these and the numerous other recommendations respecting the future of the port until a more convenient opportunity. Meanwhile, owing to the critical state of political affairs in the Far East, the security of the colony is in considerable jeopardy and misgivings of a grave character continue to occupy the minds of those responsible for its administration. All must hope that the present threat to British possessions in China will shortly be dispelled. Hong Kong, in particular, has been described as " the keystone in the arch of British trade and political interests in China," and its loss, even if only temporary, would be a severe blow to imperial prestige.

Editorial Comments – continued

Quayside Labour.

Having on several occasions recently been under the necessity of commenting adversely on certain shortcomings and irregularities on the part of labour at the quayside, which militated against the effective operation of British ports, it is agreeable to note a favourable judgment on the expedition with which cargoes are handled, by a Press Association reporter, " who had an opportunity of touring docks and shipyards in the North and found intense activity on a wonderful scale, both in the discharge of cargoes and the building and repairing of ships. Everywhere, the men appeared to be working with a will to speed up the turn-round of ships and provide more of them."

Such testimony, if the result of competent, and not merely of superficial, observation, is reassuring, and it is to be hoped that it can be taken as applicable to British ports in general. It is to be noted, however, that a " high official uttered a word of warning " to the effect that while there had been no " appreciable congestion at the docks, nothing short of a hundred per cent.. effort by all sections of the workers would achieve victory."

Indeed, hardly had the above paragraphs been written when opposition by the Glasgow dockers to the zoning scheme of the Ministry of War Transport was announced in the press.. The men have refused to attend for work at the docks specified without choice on their part. Antagonism of dock labour to discipline is fast becoming a by-word and there is little prospect of " a hundred per cent. effort " while this spirit is in evidence.

South African Port Rivalry.

Some little commotion has been agitating South African port circles lately in consequence of an appeal to traders by Mr. F. C. Sturrock, the Minister of Railways and Harbours in the Union of South Africa Government, to use Lourenço Marques in Mozambique territory for the importation of goods in order to relieve the congestion which has prevailed at the ports of Durban and Cape Town. Both East London and Port Elizabeth claim that the limits of the capacity of their respective harbours have not yet been reached and that any diversion of shipping from the Cape or Port Natal should be directed to their wharves, instead of to those of what, without due consideration of the circumstances, they term a " foreign port."

The Minister has been under the necessity of explaining the grounds for his action, which it appears is dictated by treaty obligations. Speaking on behalf of the Government, he said: " We undertook to ensure for Lourenço Marques a minimum of 47 per cent. of import traffic for the competitive area of the Transvaal. At present Lourenço Marques is handling only 35 per cent. of this traffic, but, nevertheless, we have to pay for what we undertook to provide. That is, we are paying without getting service. In the circumstances, it seems eminently reasonable to give to Lourenço Marques the share of import traffic to which it is entitled under the Convention, particularly as the Portuguese Government is scrupulously carrying out its obligations in regard to the supply of native labour to the Rand mines, which is one of the most important obligations undertaken by the Portuguese Administration under the Convention."

It is perhaps a little unfortunate that purely Union ports, such as Port Elizabeth and East London, cannot by reason of a treaty obligation, be allowed to benefit from the excess amount of traffic available at the two major ports, but there is a further drawback in the fact of the long railway haul from either of the smaller ports to the Transvaal. Moreover, as a war-time measure, the discrimination is inevitable and it will merely be temporary in operation, though the treaty obligation must still remain. Indeed, the *Johannesburg Star* points out that " Lourenço Marques is too close to the Union and too much bound up with it economically to allow of its being simply dismissed as a ' foreign port.' "

Shipping interests at the Cape have been further exercised by a movement for a " Junction Ports " scheme. Sponsored by a Committee of the Cape Town Chamber of Commerce and other public bodies, the suggestion is that transfer of cargoes destined for Great Britain should be made from slow vessels arriving at South African ports from India and the Far East into faster vessels capable of eluding submarine attack in the Atlantic. A deputation has laid the proposal before the Minister of Railways and Harbours.

Victorian Port Developments.

In a Special Report of the Parliamentary Public Works Committee presented to the State Cabinet of Victoria, Australia, in June last, various improvements were recommended for the harbours and the administration of the Ports of Melbourne and Geelong. As a result of prolonged investigation, recommendations were made for the deepening of the navigable channels to enable them to be used by ships of larger tonnage than at present, and also for the amalgamation of the pilotage services in Port Phillip Bay.

In the matter of the channels, the Committee recommended that the entrance at Port Phillip Heads should be deepened by blasting to a depth of 48-ft. The present low water depth is 43-ft. They also urged that all channels leading from the Rip Bank to the deep water berths at Melbourne should be deepened so as to permit vessels of 35-ft. draught to navigate at all tides. The present South Channel has 37-ft. depth at low water and the Melbourne Channel, a depth of 34-ft. It was further recommended that the lowering of the Spotswood sewer tunnel should be treated as an urgent matter, and the Yarra River deepened and widened to provide a navigable channel for vessels of 31-ft. draught. The depth over the Spotswood tunnel at low water is 27-ft. 6-in.

In view of the continued increase in draught of mercantile vessels, it cannot be said that the standard of channel improvement, as set out above, makes anything but reasonable provision for present and future needs. For some time past, it has been felt that the development of the Port of Melbourne has been seriously handicapped by the shallow sill over the Spotswood tunnel, and persistent representations have been made by the shipping community for the adoption of a progressive policy by the harbour authority under mandate from the Government.

During the hearing of evidence, the chairman of the Melbourne Harbour Trust (Mr. A. D. Mackenzie) stated that Station Pier and Princes Pier, Port Melbourne, were on poor foundations, and suggested that the ultimate berthage at Port Melbourne should be provided at the river entrance, where docks could be built on firmer ground. The Committee recommended that provision should be made for vessels of deep draught by the construction of dock accommodation, as suggested, instead of the erection of piers. Also, the present alignment of the Port Melbourne channel should be abandoned, and a new channel constructed, veering to the westward, to serve the proposed docks in the future.

During evidence, Mr. Mackenzie also complained of dual control of Bay waters, and instanced how oil tankers, prohibited from cleaning out holds in Harbour Trust waters, merely went to the edge of Hobson's Bay to flush the holds, and dumped in the Bay the oily water, which soon spread into the port. The Committee urged that the Melbourne Harbour Trust jurisdiction should be extended 11 miles down Port Phillip Bay.

The report further recommended that Geelong should be declared a tidal port, and advantage taken of the rise of tide to enable vessels of a deeper draft than 27-ft. to be taken in and out of the port, and that the channels should be dredged for vessels of 29-ft. draft.

The subject of pilotage arose out of the employment of both sea and harbour pilots at the ports. At present there are sea pilots to bring vessels from the Heads to Hobson's Bay, after which a harbour pilot takes charge. The report recommended that the dual system should be abolished by combining the functions of sea and harbour pilots. It also urged that pilots should be paid a fixed annual salary instead of on a tonnage basis, and that a maximum pilotage charge should be made. The Marine Board now deals chiefly with pilotage matters, and the Committee urged that the Board should be abolished and a Maritime Services Advisory Committee substituted to advise the Minister of Public Works in reference to pilotage and other functions now carried out by the board. Pilot exemption certificates should also be renewed annually, shipmasters holding exemption certificates being compelled to undergo periodical physical and visual examinations.

Another matter engaging attention in shipping circles at Melbourne is the necessity for a new large dry dock. The Alfred Graving Dock at Williamstown, at present the largest in the port, has dimensions of 459 feet by 97 feet. This is obviously quite a low standard of accommodation, only suitable for a second-rate port. It is alleged that in recent months several ships requiring attention have had to be diverted from the port on account of lack of accommodation for vessels of large tonnage. Evidently the deficiency will have to be made good at an early date, if Melbourne is to maintain its position as a leading port in the Commonwealth.

Lighthouse Beam Intensity.

On account of the divergency in the formulae used in different countries for the computation of lighthouse beam intensities, the values published in the Light Lists have little or no real significance, as they are not truly comparable. Feeling the desirability of some common basis for calculation, as voiced at a conference in this country, the British Standard Institution, at the instance of the Illumination Industry Committee, has issued a Memorandum bringing together all the available information on the subject, in an endeavour to obtain agreement on a national specification. A draft specification has been circulated for comment to all countries represented at the International Lighthouse Conference and also to those countries belonging to the International Commission on Illumination. Copies can be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3s. 6d. (postage 3d.).

Erratum.—In the September issue, there was a regrettable typographical error in the article on Ship Salvage in Harbours and Docks. In four lines at the top of left-hand column on page 231, the word " pieces " should have been " fathoms," indicating the depths at which the German battleships lay.

Coast Erosion

The General Question of Coast Erosion and Measures Desirable for Prevention of Damage caused thereby; and the Drainage of Low-lying Lands*

By T. B. KEAY, A.M.Inst.C.E., A.M.Inst.M. & Cy.E.

Evolution

THE evolution of the British coastline is at once so interesting and involved that it is unfortunate only brief reference to it can be made in this Paper. Although it is the erosion which is taking place to-day with which the present generation of Engineers must concern themselves, a full understanding of all the factors in past developments is a desirable preliminary to any serious study of this question.

It must first be understood that both rapid and intermittent changes in the relative levels of land and sea have occurred in past ages, the present coastline of England and Wales owing its origin to a submergence which took place about 3,500 years ago, and it is only since that time that the coast erosion under discussion has been going on. It has been estimated that the present sea level is 60-ft. above that existing in prehistoric times.

Where the land surface had been worn by stream action into hills and valleys at the time of this partial submergence, the result was a coastline of bays and headlands, e.g., South-West England and West Scotland; but where the land surface was comparatively plain and little cut up by sub-aerial action, the submergence resulted in the formation of an even coastline.

The subsequent action of the sea on all types of coast is towards the production of a coastline more or less regular; on an irregular coast, cliffs form at the headlands, while accretion occurs in the bays, different parts of our shores having advanced to a varying extent towards this regularised state.

The rate and amount of erosion is determined largely by the nature and arrangement of the geological formations. Thus, the coasts of Cornwall and Devon have been but little affected by erosion, for they are formed of resistant hard igneous and ancient sedimentary rocks, see fig. 1, but the second and more recent rocks found on the South Coast are less resistant to erosion and this has resulted in the formation of long stretches of regular shore lines worn by the sea to a smooth outline. It is the East Coast of England, however, which has suffered the most, especially Holderness, Norfolk and Suffolk. Here the coast consists of boulder clay, gravels and sand of the glacial drift which are incapable of seriously resisting wave attack (see fig. 2). Villages which have disappeared beneath the waves in Holderness, are, Wilsthorpe, Auburn, Hartburn, Barmston and Ravenspur, while the average rate of erosion of this coast is estimated at 11-ft. per annum, the sea having advanced over 3 miles inland since the Roman Invasion. Figure 3 is an example of damage done on the East Coast.

Fig. 1. Typical West Country Coastline.

Compare this with a rate of about 3 yds. in parts of Cornwall and the great variation in the geological systems obtaining in the British Isles becomes apparent.

Were man not to interfere with the natural processes, all coasts would eventually become bordered by cliffs and the sea would then gradually advance landwards on all shores. The present seaward growth of certain shores, more fully discussed later in the Paper, and the regularisation of the coast outline are but incidents in this slow retirement of the whole coast.

The considerations affecting the erosion and development of our coasts are indeed numerous, the more important of which will now be considered.

Sub-Aerial Erosion

This causes modifications in those parts of the coast high above high water mark and this weathering contributes directly to the material at cliff bases and, by means of rivers, to the supply of detritus upon the shore.

Under this heading it may also be mentioned that land springs and land drains, where discharging on the face of a cliff, considerably hasten erosion by causing the material of the cliff face to become loose.

Erosion Due to Geological Structure Alone

In several cases the erosion caused by the sea is small when compared with the loss of land occasioned solely by the geological structure. On many parts of our coasts the cliff consists of alternate strata of gravel, sand or chalk overlying clay and where, as is often the case, the strata dip towards the sea, water lubricates the surface of the clay so causing slips. Figure 4 is an example of a slip of about half-a-million tons of earth which occurred in 1937 at Folkestone Warren. The clay slid under the wall, came up on the foreshore and destroyed the groynes, the wall being pushed 90-ft. out to sea at one end.

Marine Erosion

In the main, the erosion of our shores is due to marine action in the nature of wind-formed waves assisted by tides and currents, the amount of wave attack being governed by the degree of exposure of the coast to far-travelled deep-water waves, by the aspect with regard to the prevailing and dominant winds and their force and frequency.

Fig. 2. Erosion at Frinton-on-Sea

*Paper read before the Institution of Municipal and County Engineers and reproduced by permission.

Coast Erosion—continued

Fig. 3. Example of Destruction near Lowestoft.

Although the force of impact of waves is often tremendous, the greatest recorded force being 3½ tons per square foot, it is more often the scour, or especially on rocky coasts the fact that the sea is loaded with boulders, hard gravel and sand, which causes the erosion.

Seas which do most damage usually occur during an off-shore gale, as the wind holds up the water in large waves and in addition a heavy ground swell forms; beach material, however, accumulates. With on-shore gales the reverse happens—serious damage rarely occurs, but depletion of the shore takes place.

The rate of erosion of a coast also depends upon under-water erosion, for unless the inshore waters deepen, wave advance cannot proceed. Where under-water abrasion is slow, the advance of the sea is retarded, but where it is rapid, as along the Holderness Coast, the inshore waters remain deep and wave action powerful, thus causing continual rapid retreat of the coast.

Erosion and the Supply and Distribution of Beach Material

Coastal development also depends upon the supply and distribution of beach material. It will be seen later that the ideal natural protection for the easily-eroded coast is a foreshore of shingle and sand and it therefore follows that some erosion is desirable to replace beach material unavoidably lost to the sea.

The problem confronting engineers, to retain on the foreshore the beach material, which is almost entirely derived from cliff erosion, is by no means easy, as natural movements in definite directions exist, being generally due to wave action as governed by the prevailing winds. This littoral drift, which may be arrested by headlands, river mouths, harbours, piers and groynes, is from north to south on the East Coast, from west to east on the South Coast from South to North on the West Coast as far as Morecambe Bay, from north to south between Morecambe Bay and Workington, and again from south to north from Workington to the Solway Firth.

Generally, the drift occurs between the marks of high and low water, although movement takes place as far out as the edge of the Continental platform, evidence existing to show movement up to a depth of 70 fathoms. Material travels both to and from the shore as well as along it, water running at less than ½ knot moving sand along the sea bottom, while at 4½ knots, stones weighing 20 lbs. are moved.

Sometimes beach material, by accumulating off-shore in the nature of shoals or sandbanks, affords protection to the coast by breaking the force of the waves, but the under-water scour between the bank and the shore is increased, while the movement of these shoals gives rise to the intermittent erosion found at different points on the East Coast.

Organic Erosion

It may not be widely realised that erosion below water level on some parts of the coast, e.g., Norfolk and Selsey Bill, is increased by rock-boring organisms such as *Cliona* (a sponge) and *Leucodore* (a worm) which are capable of lowering chalk sea-bottom at the rate of one inch per year.

Erosion Due to Human Agency.

The efforts of man to prevent erosion are sometimes but the cause of its increase, either at the site of his works or elsewhere along the coast. Protection works when badly designed in themselves may cause considerable additional erosion, see Figure 5, while on the other hand, works may be so effective in holding up the beach material that parts of the coast to leeward are deprived of their natural protection and are so laid open to attack.

Harbour projections also arrest the travel of material to the detriment of the coast to leeward and erosion usually takes place, e.g., Yarmouth and Lowestoft.

A further cause of erosion is the practice, often allowed, of removing sand and shingle actually protecting the shore, for the use of builders and contractors.

Accretion and Reclamation

To some extent the coast erosion taking place at the present time is counter-balanced by a process of natural accretion and reclamation, sometimes assisted artificially. Along parts of the coast of Lincolnshire and at Dungeness, for example, sand and shingle have been driven by storms above high water mark, so forming a natural protection. In time this leads to silting up, formation of salt marshes and eventual reclamation. Also, where the coastal lands are low-lying and the flat sandy foreshores are exposed, on-shore winds pile up the sand to form sand dunes, thus enabling large areas of marsh land (in many cases below H.W. level) to be converted into valuable pasture. Figure 6 shows sand dunes on the East Coast protecting the coast plain of Lincolnshire which was, until comparatively recently, largely submerged and flooded by both fresh and sea water.

Accretion in the nature of alluvial flats also occurs. These latter are composed of the finer material derived from the land, mainly brought down by rivers and deposited in the sheltered estuaries such as the Severn, Wash and Humber, forming salt marshes which, in time, may be completely reclaimed by artificial means.

Erosion v. Accretion

Considering England alone, more land is being gained in actual area at the present time, by accretion and reclamation, than is being lost by erosion. Much of the accretion, however, is of no immediate value and in addition must be artificially protected, while erosion deprives the country of valuable land, some authorities estimating that we forfeit every year a tract of land equal to the size of Gibraltar.

Alluvial flats of vast areas have been converted into fertile land, e.g., since Roman times about 63,500 acres of land has been reclaimed in the Wash and 7,000 acres in the Humber, but estuaries where future reclamation is possible are definitely limited.

Nationally, the present erosion, according to the Royal Commission on Coast Erosion, is not alarming, but in view of the destiny of ultimate destruction of the land, it is the Author's contention that works of protection should be undertaken whenever financial conditions permit, especially on the East and South-east Coasts.

Fig. 4. Slip of Clay Cliffs at Folkestone.

Coast Erosion—continued

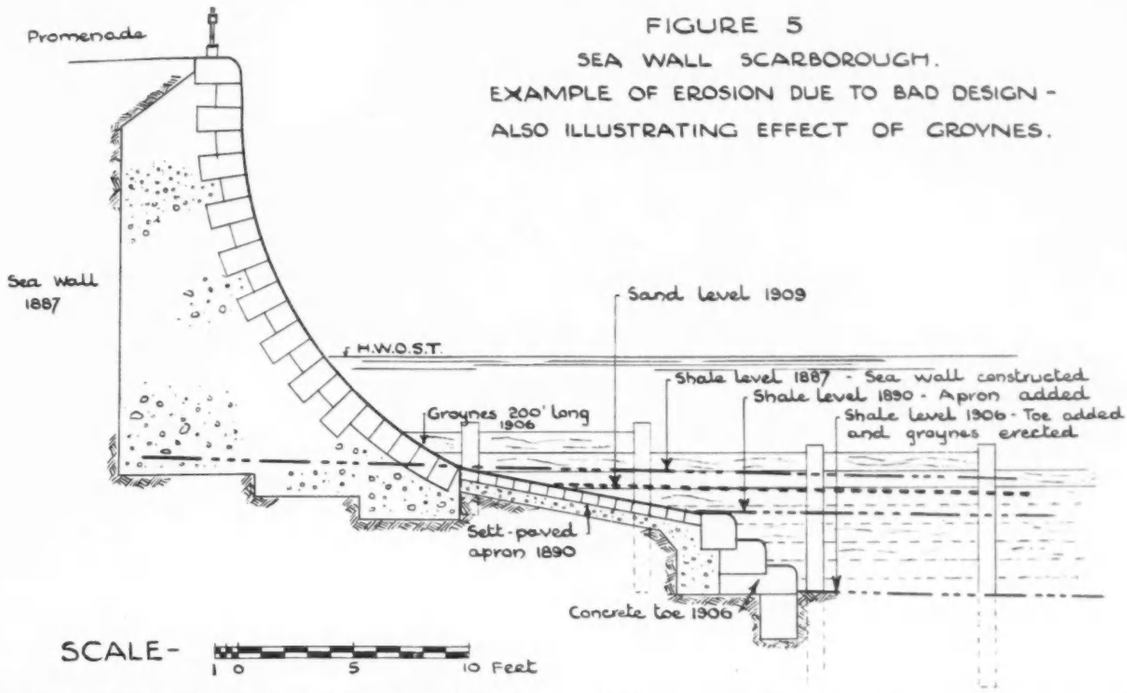


FIGURE 5
SEA WALL SCARBOROUGH.
EXAMPLE OF EROSION DUE TO BAD DESIGN -
ALSO ILLUSTRATING EFFECT OF GROYNES.

MEASURES DESIRABLE FOR THE PREVENTION OF DAMAGE

General Considerations Including Financial

The practical measures to be taken for the prevention of damage, such as loss of land and property, caused by coast erosion, aim at preventing wave advance and preserving beach material, as a natural shore of sand and shingle, assisted where necessary by artificial means, forms the best possible protection. It is where the eroded material is immediately swept seawards, instead of travelling parallel to the shore and permitting accumulation, that the most difficult question arises.

The retreat of the coast before the sea is resisted by each succeeding generation according to ideas of the day, some of which in the past have assisted erosion rather than the opposite, as previously mentioned in this Paper.

Basically, protection works take the form of sea walls or revetments to prevent wave advance, combined with a system of groyning to encourage and retain beach material, but they are not usually undertaken until the erosion is economically serious. For example, where erosion of agricultural land bordered by cliffs is occurring, it is not economically protected unless in the vicinity of towns, the value of the land being far less than the cost of protection works; but if vast areas of rich agricultural land are liable to inundation by the sea while unprotected, the cost of works would probably be warranted, as such flooding by sea water ruins the land for several years.

An essential preliminary to all works of coast protection or land reclamation is the study of the local natural conditions. These incude levels, formation and exposure of beach, the set and velocity of tidal currents, the range of tides and direction of winds, and the travel of the beach material.

Fig. 6. Sand Dunes protecting Lincolnshire Coast.

It is now proposed to deal with appropriate measures, bearing in mind throughout the importance of maintaining some travel of beach material so as not to deprive the shore to leeward of its natural protection.

Sea Walls

These are not often found at places along the coast other than at or near towns as their expense generally prohibits their use in other localities. In conjunction with the construction of a sea wall it is usually found necessary to erect groynes for the purpose of maintaining or raising the beach and protecting the wall foundations.

Naturally the detailed design of protection works is beyond the scope of this Paper, for sea walls and other works must be varied to suit the different conditions found round our shores. Walls are used for retaining the promenade at sea-coast towns, for preserving the bases of cliffs, or for the protection of low-lying lands from inundation. Their bases should be carried down to a solid foundation such as rock or chalk, if possible, and they must be strong enough to resist the heaviest sea.

In profile, vertical, straight-battered, stepped and curved walls are found, but undoubtedly the most satisfactory form is the stepped wall as constructed at Bridlington, Wallasey, Mablethorpe, etc. Figures 7 and 8 show various types of walls. Curved walls induce scour, while stepped walls break up the recoiling wave and minimise this effect. Walls should have an overhanging cornice to deflect the water and so keep the promenade dry, and often it is desirable to construct aprons at the foot of the wall and protect them by sheet piling. Sea walls may be constructed of mass-concrete or reinforced concrete and be pre-cast or cast in situ.

Where the shore consists of sand, concrete faced walls may be employed, but where abrasion by shingle occurs, the older and more expensive method of facing with granite or basalt is nowadays replaced with a facing of pre-cast flint-faced or granite-faced concrete blocks.

Many different types of sea walls are encountered, the most suitable design being mainly dependent upon the local conditions obtaining, such as force of waves, nature of beach material, necessary height, materials available, and the all-important item cost; this latter may be anything from £30 to £100 per lineal yard of wall.

Revetments and Stockades

The protection of land of low value, while not justifying sea walls, is often very necessary and may be achieved by the use of timber, pitched or reinforced concrete revetments in certain circumstances. Timber protection to embankments is now largely replaced by reinforced concrete slab facing held in position by a system of concrete beams closely spaced to prevent cracking of the slab, as at Frinton-on-Sea.

Coast Erosion—continued

Longitudinal stockades running parallel to the shore, in the form of rows of piles, have been used to assist accretion of the shingle foreshore on the Somerset Coast, but they are not suitable on sandy beaches.

Fig. 7. Stepped Sea Wall at Mablethorpe.

Stockades are also useful to protect low sandhills; together with gorse and brushwood, they encourage the deposition of wind blown sand and higher dunes result.

Groynes

As already stated, sea walls should seldom be constructed alone. A system of groynes for the accumulation of a beach should be built simultaneously with the wall for its protection. Groynes are of course also used to maintain or raise a beach whether or not a wall exists.

Groynes should be in groups and never used singly and in order to ensure the travel of sufficient beach material for the protection of the coast to leeward, the last few of a series of groynes may be made of a gradually decreasing length.

Numerous classes of groynes are in use and again local conditions and peculiarities of the coast determine the design. Generally groynes should extend to at least low water mark, but must be kept low at the outer end; they should be above the highest water level at the shore end and be built into the longitudinal defence. Common practice is to space groynes at a distance apart equal to their length, but high groynes must be nearer together than low groynes.

The most suitable angle with the coast is a debatable point, being governed by local circumstances, but they are commonly found at right angles to the shore or pointing slightly to windward.

Groynes may be high or low, but they should never be higher than necessary. On the South Coast where steep shingle beaches are found they must be high, but the East Coast conditions of wide, sandy shores, are eminently suitable for long, low groynes, which should be kept low and raised as the beach accumulates, e.g., Figure 9, which shows a type of "Case" groyne.

Many different types of groynes are used, as shown in Figure 10. Solid concrete is suitable for foundations of rock or chalk, travel of beach material being maintained by means of openings in the groynes; reinforced concrete; timber groynes of the "Case" type which lend themselves to easy adjustment in height; timber or concrete sheet piled groynes; "Du-Plat-Taylor" patent screw pile adjustable groyne; flexible groynes, suitable only for firm sandy shores, consisting of reinforced concrete slabs held together by cable chains or wire ropes; and chain-cable groynes, which are more or less temporary, consisting of heavy cable chain with brushwood and branches attached.

Cliff Protection

Cliff protection works fall into two classes: (1) works to resist slips due to the geological structure, and (2) those to protect the base of cliffs from sea erosion, both types being expensive and usually found at or near sea coast towns only.

Works in the former category include: (a) drainage of the cliff, especially at the lower level, and catchwater drains at the top of the cliff to intercept land water, (b) walls at the foot to hold up the cliff, (c) sloping of the cliff face to render stable, and (d) laying of grass sods to protect the face. See Figure 11.

In the latter category we have (a) sea walls to prevent wave attack, (b) groynes to accumulate beach, (c) wave-breaker walls in front of the cliff, and (d) the protection of a sloping base by continuous concrete or pitched revetments.

Fig. 9. Low Timber Groyne on East Coast.

Sand Dunes

Dunes, where formed, should be preserved and encouraged by faggoting, stake and wattling, and planting, the most suitable grasses and plants being marrum, lyme-grass, sand-sedge, wild thyme, gorse and sea-buckthorn.

EXAMPLES OF SEA WALLS. FIGURE 8

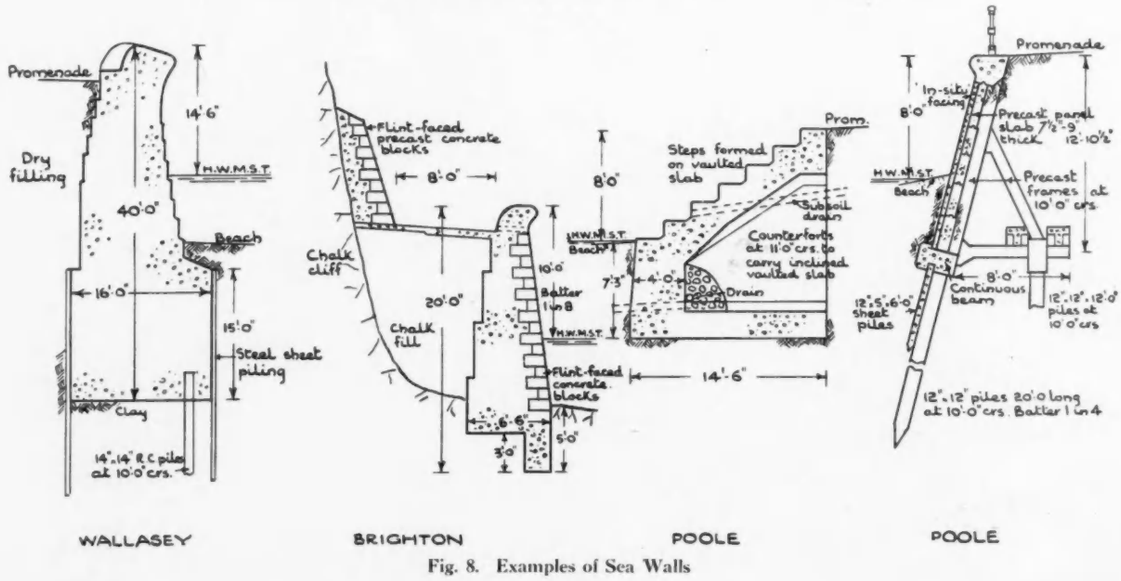


Fig. 8. Examples of Sea Walls

Coast Erosion—continued

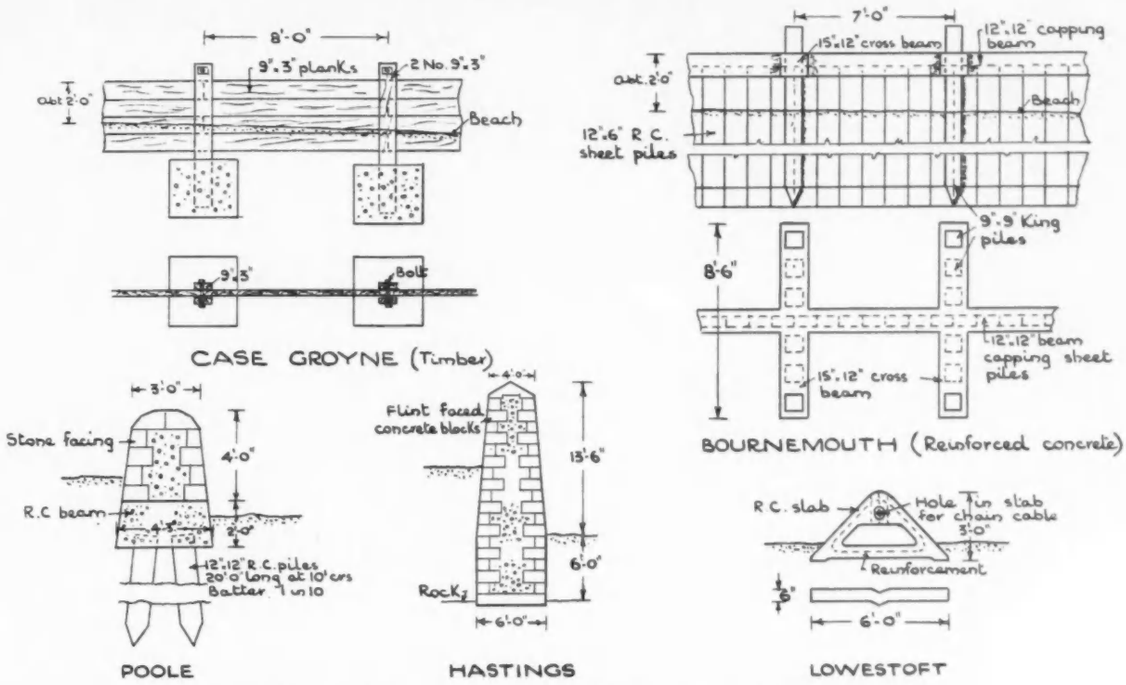


FIGURE 10. EXAMPLES OF GROYNES

Maintenance of Existing Works

All classes of coast protection works should be efficiently maintained, repairs being executed promptly. In this connection it is interesting to note that the face pressure of a wave may be increased up to 16 times if open joints or fissures occur in the wall face: hence the importance of maintenance.

The removal of beach material has been mentioned as a cause of erosion and this practice should be prohibited where the sand is serving a protective purpose.

Reclamation

It is often said that "attack is the best defence" and wherever possible reclamation of accreted land should be carried out.

Naturally accreted land first grows into salt marsh, but this is not fit for permanent enclosure until about 25 years after grass appears. Accretion may be assisted by planting rice-grass, etc., and the level should be raised to near the height of ordinary spring tides before enclosing.

Statutory Measures

Among the measures to combat coast erosion, there must be included what constitute, in the Author's opinion, necessary changes in the administration of the coastline, which must be enacted by Parliamentary decree.

At the present time the coastline is administered by numerous authorities who are responsible only for their own particular tract, and thus, the problem of coast protection is never considered as a whole, but always in disconnected sections. This method does not give the best results for it often leads to the construction of defences of the wrong type and the unequal distribution of beach material.

As recommended by the Royal Commission, a Central Sea Defence Authority, being the Board of Trade, should be formed to administer the coastline in the best interests, power being given (a) to control the removal of material and the construction of protection works, (b) to supervise existing coastal authorities in work of protection, and (c) to create new authorities where necessary.

To this end a Coast Protection Bill was introduced in the House of Commons in 1929 but it was dropped after the second reading.

That the present Government do not consider coast erosion to be nationally serious is shown in a statement made by the then Prime Minister in the House in 1938, when he reiterated the Royal Commission's recommendation that grants for defence works, or payment of compensation for damage, were not justified.

Conclusion

Sea action was described in a Statute of Henry VIII as the "outrageous, flowing, surges and course of the sea" and this is shown to be so by the fact that approximately £2,000,000 have been spent in quite recent times on defence works at coast resorts.

Unless means can be found to stop that gradual deepening of inshore waters which must lead to increased wave attack, additional erosion and the eventual destruction of our existing works is inevitable.

Perhaps the conversion of the terrific tidal forces into useful, instead of destructive, energy, by the successful culmination of tidal hydro-electric projects, will provide the solution.

(To be continued)

EXAMPLE OF CLIFF PROTECTION.

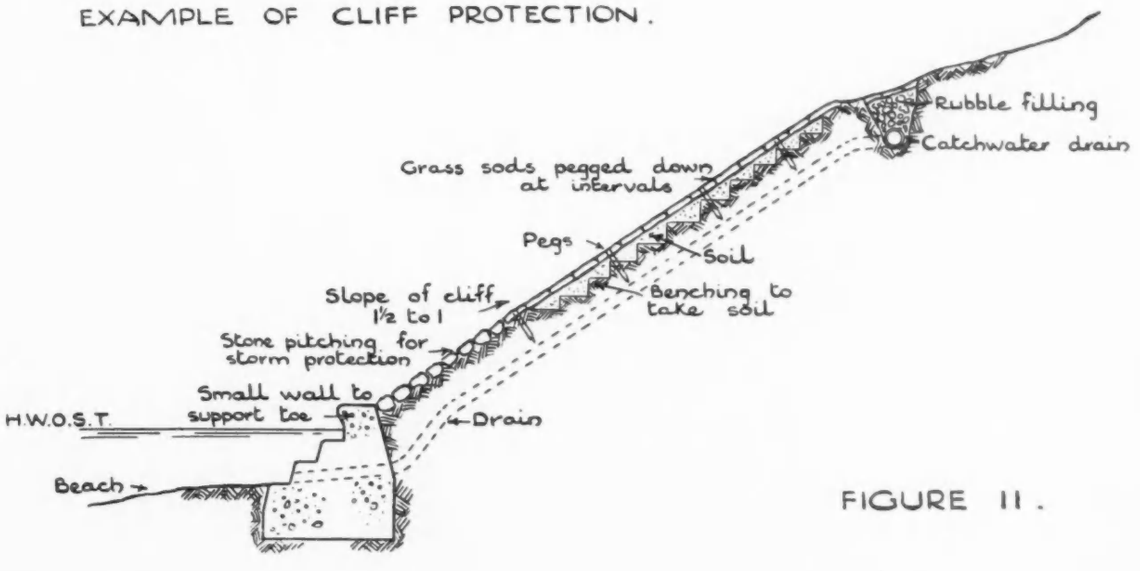


FIGURE 11.

Notes of the Month

Tunnel under the Tyne.

Plans for a tunnel under the Tyne, estimated to cost £1,950,000 have been approved by the Northumberland County Council.

Enlargement of Port Vigo.

It is announced that the Spanish Cabinet has approved a Bill making provision for the enlargement of the Port of Vigo in North-west Spain.

New Quayside Sidings at Stockton-on-Tees.

The installation is in progress of six new sets of quayside railway sidings at Stockton-on-Tees for the purpose of linking up the Corporation Quay with North Shore Station. Excavation and levelling operations are well in hand.

Death of Ship Canal Official.

Formerly deputy-manager of the Manchester Ship Canal, Mr. George Hazlehurst, O.B.E., has died at the age of 74. He was also, for a time, manager of the Millwall Docks, London, and after retirement on pension at the time of the creation of the Port of London Authority, he returned to the service of the Ship Canal at the Manchester Docks, finally retiring a second time, 15 years ago.

Port Traffic at Kotka.

In a report on the trade of the port during 1940, Kotka Harbour Board, Finland, states that navigation was reopened on March 20th and continued until the end of the year. During the year, 1,481 vessels, of 428,969 tons net, visited the port, compared with 3,069 vessels, of 1,654,207 tons, in 1939; 575 of the vessels were engaged in foreign trade, against 1,576 in 1939.

Walsh Island Floating Dock.

A floating dock with a capacity up to 15,000 tons is being assembled at Walsh Island, at the port of Sydney, New South Wales, and is expected to be in working order by November. Hitherto it has been used in two sections for vessels of smaller size. The combination for the use of greater tonnage involves a certain amount of dredging at the site and approaches.

Port Welfare Facilities on Tyneside

In continuation of a programme of welfare work for seamen at Tyneside ports, premises have been secured in Bath Lane, Newcastle, and elsewhere for conversion into hostels for the use of British and foreign seamen. It is also proposed to remodel the Missions to Seamen's hostel at Blyth at an estimated cost of £6,000, and further developments are contemplated at North Shields.

New Naval Repair Base at Balboa.

During a recent visit to locality, Rear-Admiral Frank H. Sadler, of the U.S. Navy, announced the U.S. Government's intention of establishing at Balboa in the Panama Canal Zone, a naval repair base capable of accommodating " a good part " of the American Fleet, including the largest battleships. A unit of the third set of canal locks, now under construction, will be equipped as a large dry dock.

Development of North Carolinan Harbours.

The United States Corps of Engineers have in hand a project for dredging an entrance channel in Silver Lake Harbour, North Carolina, with a length of 900 feet and a width of 60 feet. An anchorage area is also to be provided, varying in width from 350 feet to 850 feet and approximately 1,700 feet in length, with a new approach channel 3,200 feet long and 100 feet wide. It is in contemplation to dredge a channel 25,000 feet long and 100 feet wide in Manteo Bay, leading to Oregon Inlet.

Port of London Authority Changes.

Vice-Admiral J. A. Edgell, C.B., O.B.E., Hydrographer of the Navy since 1932, has been appointed by the Admiralty as their official representative on the Port of London Authority in succession to the late Admiral Sir Frederick Learmouth. Admiral Edgell has been co-opted on the River and the Stores Committees. Mr. Percy Wharton has been co-opted a member of the Board in place of Sir Alfred Read, J.P., who has resigned his seat. Sir Alfred, who was a representative of Payers of Rates (Vessels), had been a member since 1934.

Traffic at Port of Calcutta.

A return made by the Commissioners for the Port of Calcutta shows that during the twelve months ended 31st March last, entrances numbered 1,193 vessels of 3,472,896 net tonnage, and clearances 1,208 vessels of 3,520,960 net tonnage. For the previous year the figures were: Entrances, 1,406 vessels of 4,559,733 tons, and clearances, 1,409 vessels of 4,589,812 tons. The quantities of cargo handled for the same two periods were: 1941, imports, 2,322,849 tons; exports, 5,425,049 tons; 1940, imports, 2,948,671 tons; exports, 7,017,240 tons.

Death of Harbour Trust Vice-Chairman.

Captain J. H. Maurice Clarke, R.N.V.R., a former president of Glasgow Chamber of Commerce and Vice-Chairman of the Clyde Navigation Trust, has died at the early age of 49. He was one of the best known yachtsmen on the Clyde. Latterly his services had been given to the Admiralty

Retirement of Long Service Port Officer.

After more than 43 years' service with the London and South Western and the Southern Railways, Mr. S. C. Baker has retired from his post as chief clerk to the Dockmaster at Southampton, having commenced his service as a junior clerk in the same department as far back as 1898.

Trade on River Delaware.

Statistics contained in a report issued by the United States Engineer Office at Philadelphia show that water-borne commerce on the Delaware River in 1940 was the greatest on record and increased by 11.7 per cent. over the figures for 1939. The net volume of commerce was 42,087,213 short tons, in contrast to 37,680,077 tons in the previous year. Vessels in foreign, coastwise and intercoastal commerce numbered 16,842 inbound and outbound, with loaded draught ranging from 8 feet to 33 feet.

Durban Port Appointment.

Following representations made to the Government of the Union of South Africa that such a post was necessary in order to cope with accumulated and emergency traffic, Colonel J. D. White, present Deputy-General Manager of the Railways, has been appointed Director of the Port of Durban. His duty will be to keep ships moving as regularly and expeditiously as possible, to decide questions of priority in regard to ship repairs and dry dock work, and generally to facilitate the smooth working of the port.

Changes in Mersey Dock Board Membership.

On grounds of ill-health, Mr. R. D. Jones, a representative of the Liverpool Steamship Owners' Association, has relinquished the seat on the Mersey Docks and Harbour Board, which he has held since 1936. Mr. Jones had been a member from time to time of the Docks and Quays, the Pilotage and the Works Committee. The vacancy created has been filled by the appointment of Mr. Thomas J. Tierney, chairman of the Liverpool Shipowners' Association and managing director of Richard Hughes and Co. (Liverpool), Ltd.

The Proposed New Dry Dock at Cape Town.

The Hollandsche Aanneming Maatschippij, Dutch contractors for the dredging work at the new basin at Cape Town, South Africa, have been asked by the Union Government whether they will be in a position to undertake reclamation work on the site of the proposed new dry dock when their present contract is completed, and if so, to submit a provisional tender for the work. Difficulties in the obtainment of material for repairs to plant and additional spares, as also insufficient supplies of skilled labour may cause a postponement of operations. A plan for the proposed dock prepared by Mr. G. R. Lankester, the harbour engineer, has been laid before the Harbour Advisory Board.

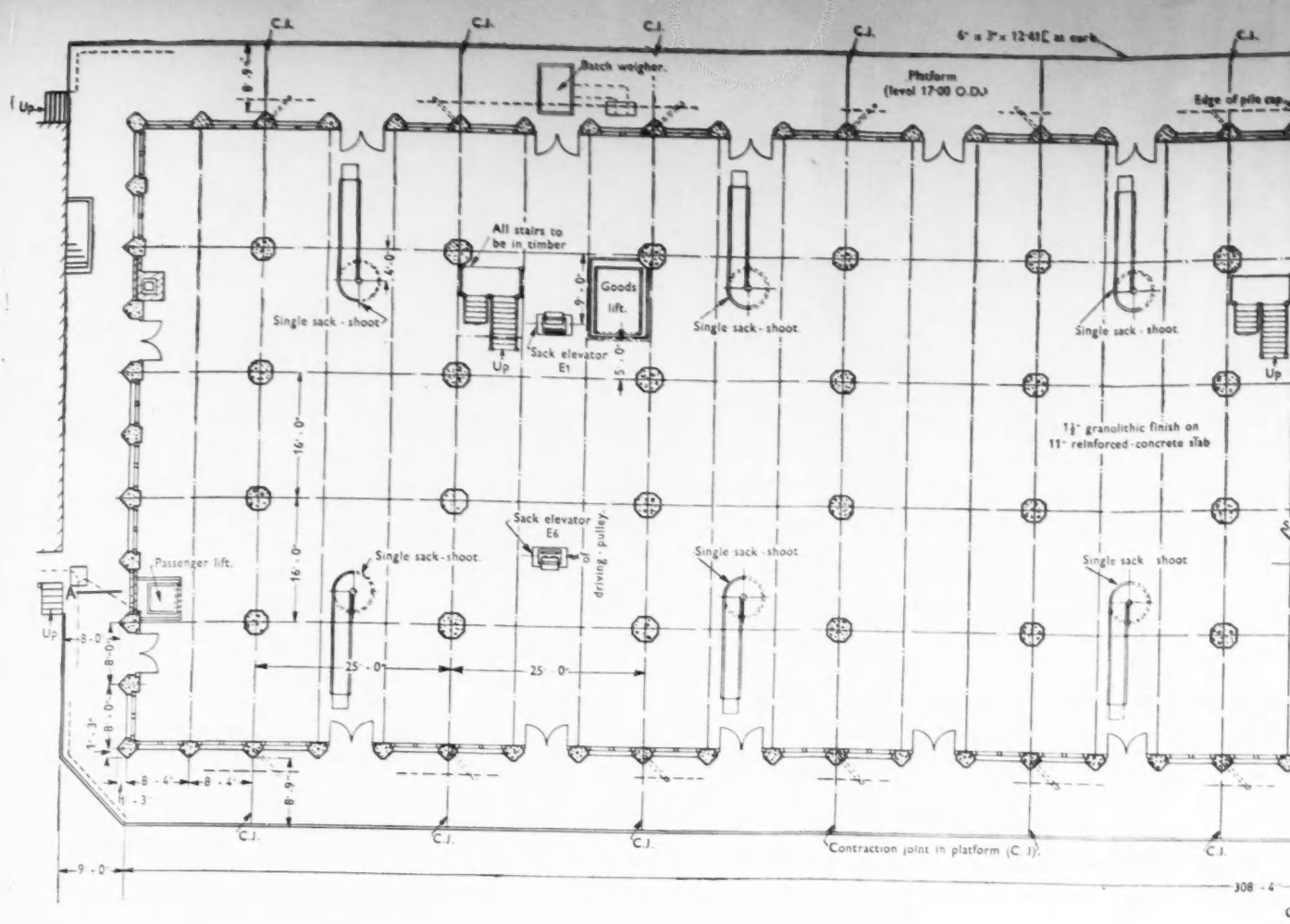
Vulnerability of Port Structures in the U.S.A.

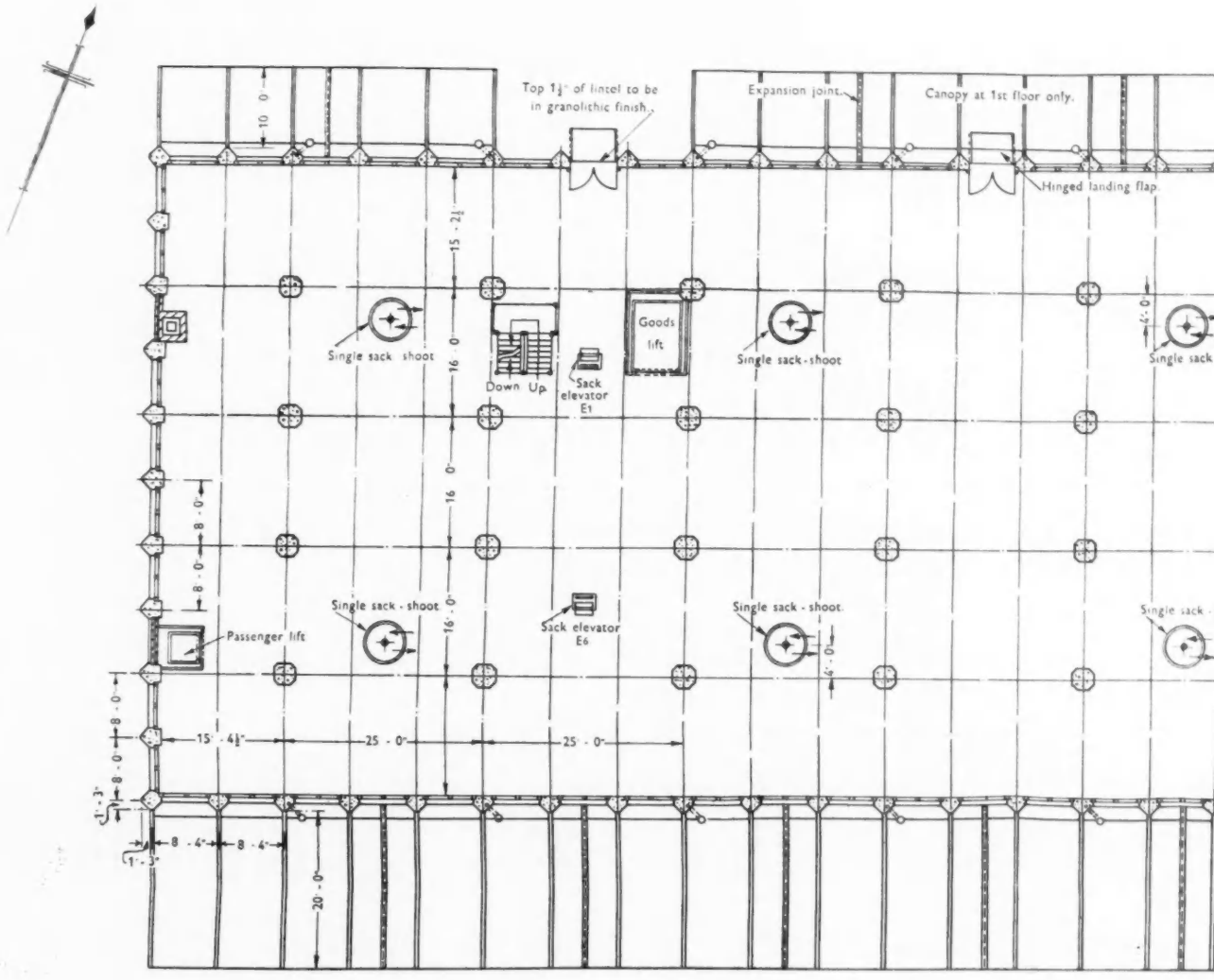
In a report on the great fire at Jersey City, New Jersey, U.S.A., on May 31st last by Mr. W. G. Hayne, an engineer, who investigated the outbreak on behalf of the New York Board of Fire Underwriters, it is said that the survey had disclosed that " the major number " of water front structures in ports of the United States were of " combustible construction and that few ports had any definite laws " governing water front construction with respect to fire prevention. Mr. Hayne recommended that a " model ordinance," prepared subsequent to the survey to ameliorate the condition, " be considered by the Jersey City authorities as well as other port authorities throughout the United States."

Increase in Dock and Canal Charges.

A number of Orders has been issued by the Ministry of War Transport permitting an increase of charges in respect of certain canals and docks. The Orders have been put into force and apply to Milford Docks, the Aire and Calder Navigation, the Calder and Hebble Navigation, the Sheffield and South Yorkshire Navigation, the Tees Conservancy Commission, the Trent Navigation and Nottingham Canal. The increases permitted vary from 16 2-3rds per cent. in the case of the canal rates of the Aire and Calder Navigation to 100 per cent. in the case of the Tees Conservancy Commission, and are based upon the rates charged on September 3rd, 1939, with the exception of Milford Docks, where the increase is upon the rates scheduled in the Milford Docks Act, 1919.

Waterside Flour



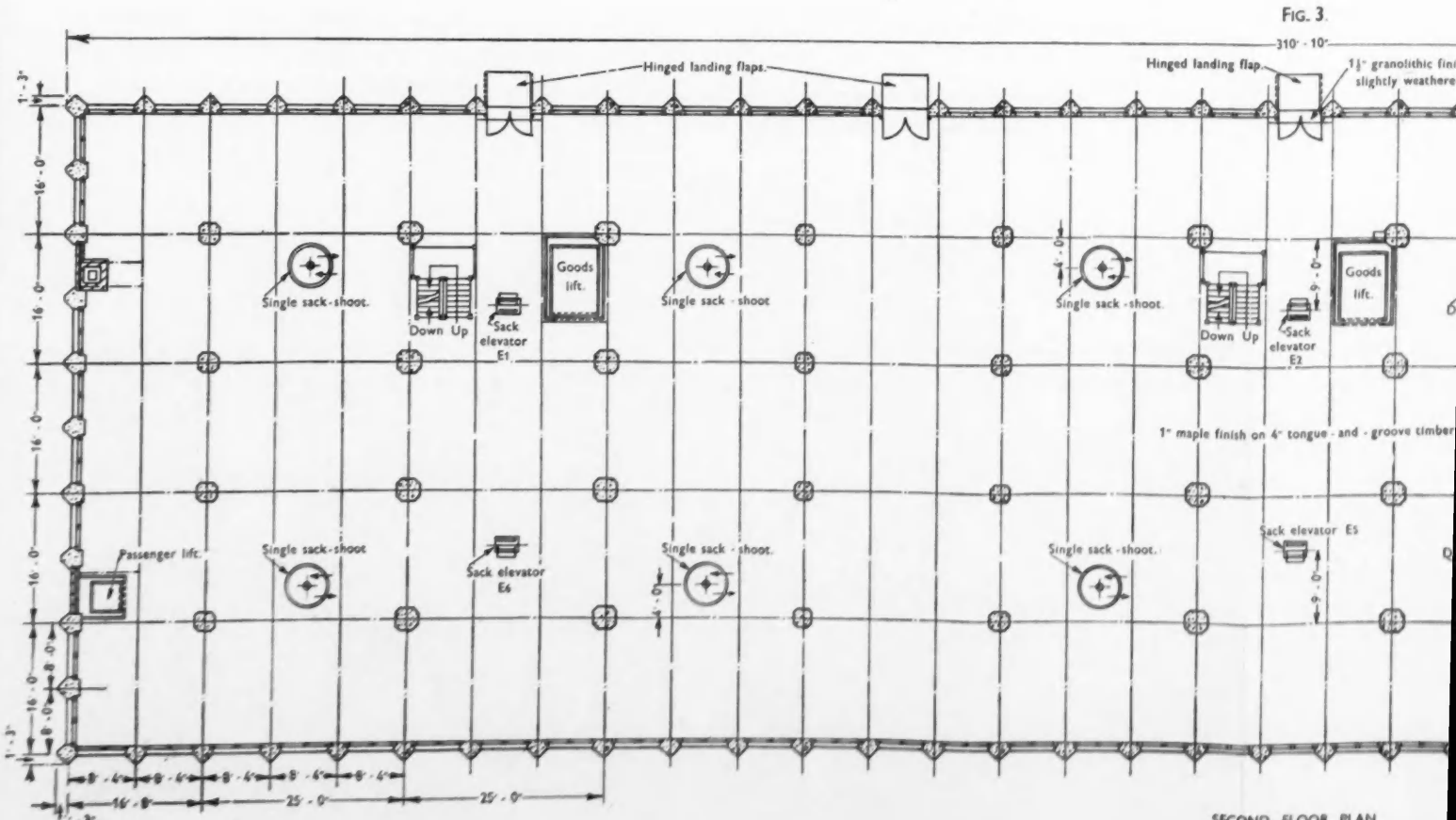


Scale: 1" = 20 feet

0 8 6 4 2 0 10 20 feet.

GRANARY FOR THE SOUTHERN RAILWAY.

FIG. 3.



SECOND - FLOOR PLAN.

3rd. 4th. & 5th. Floors similar.

FIG. 1.

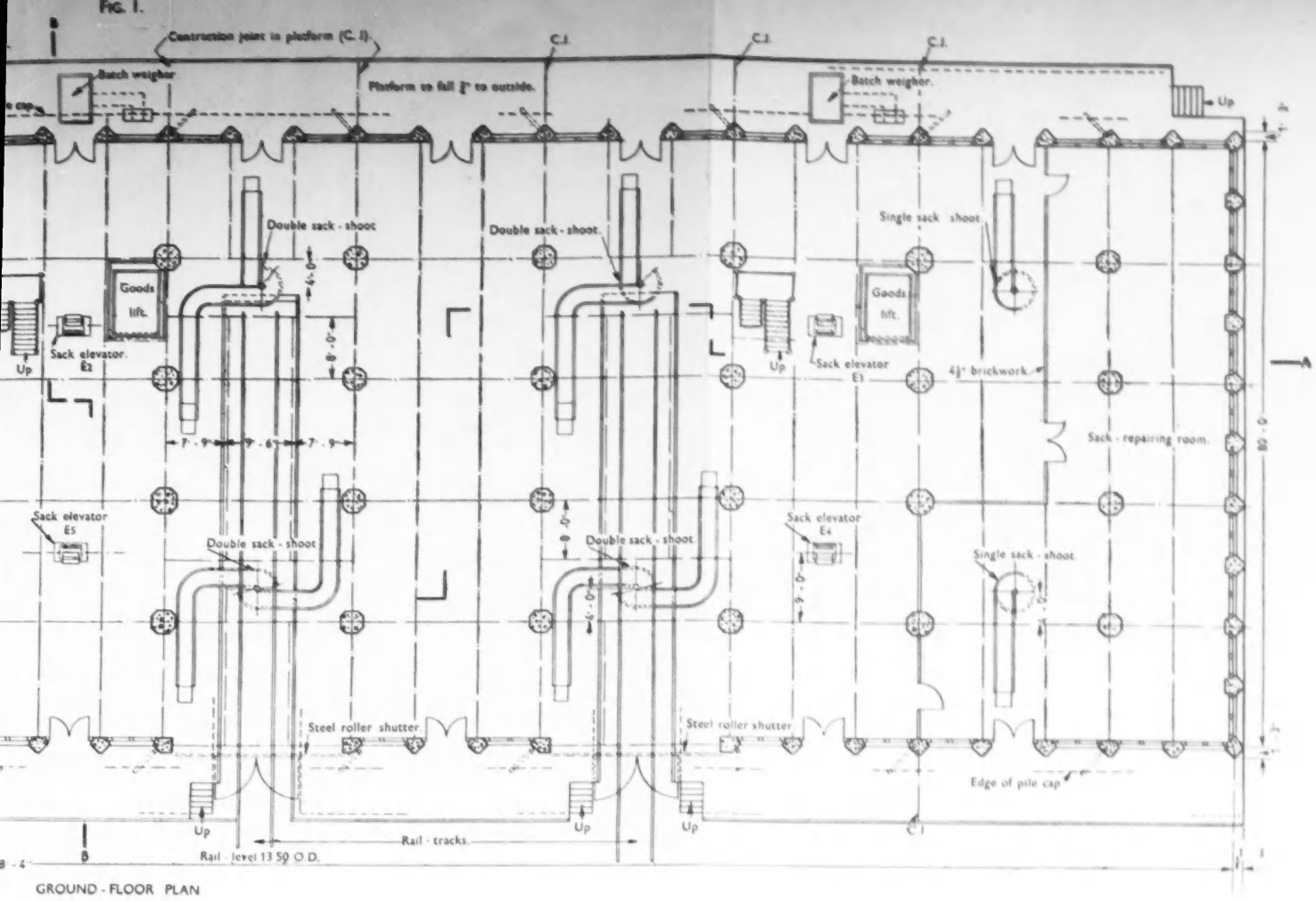
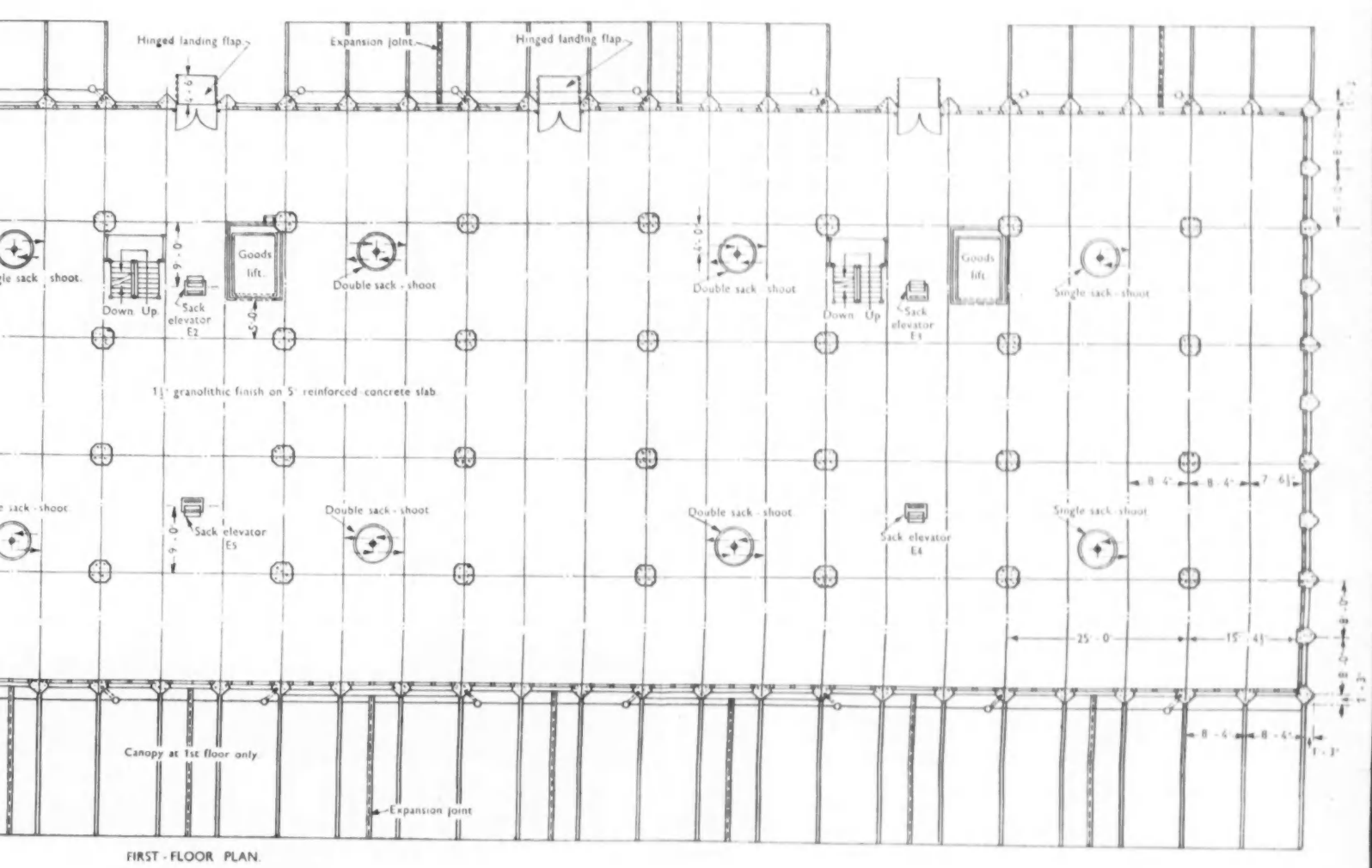
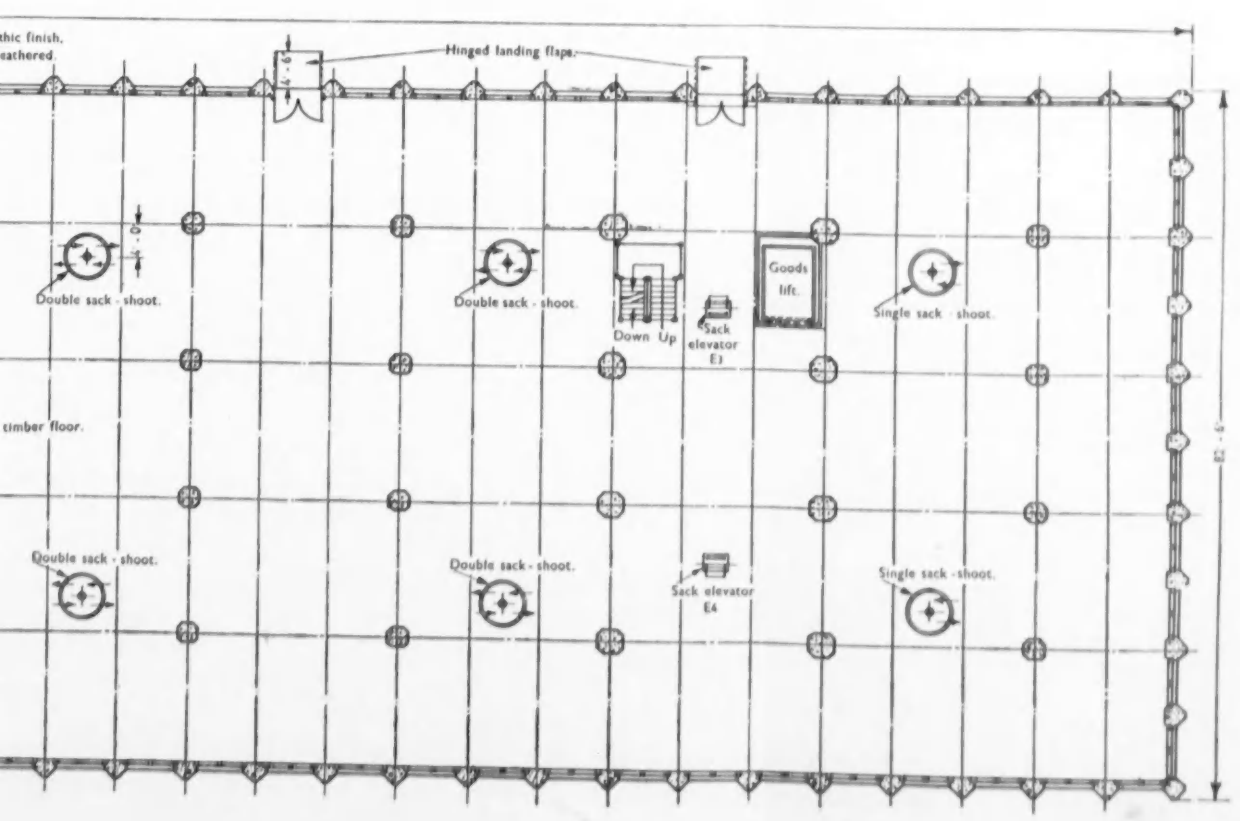


FIG. 2





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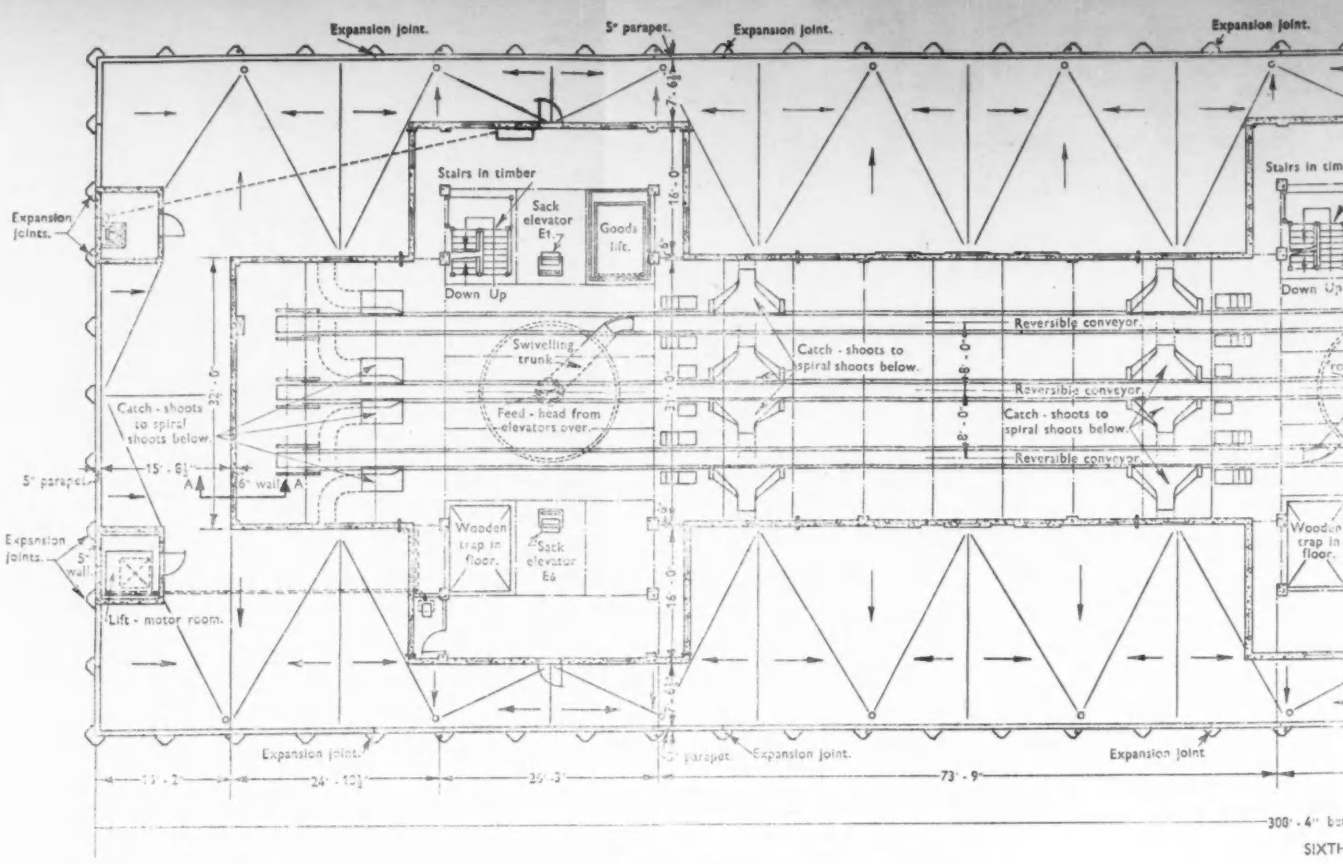
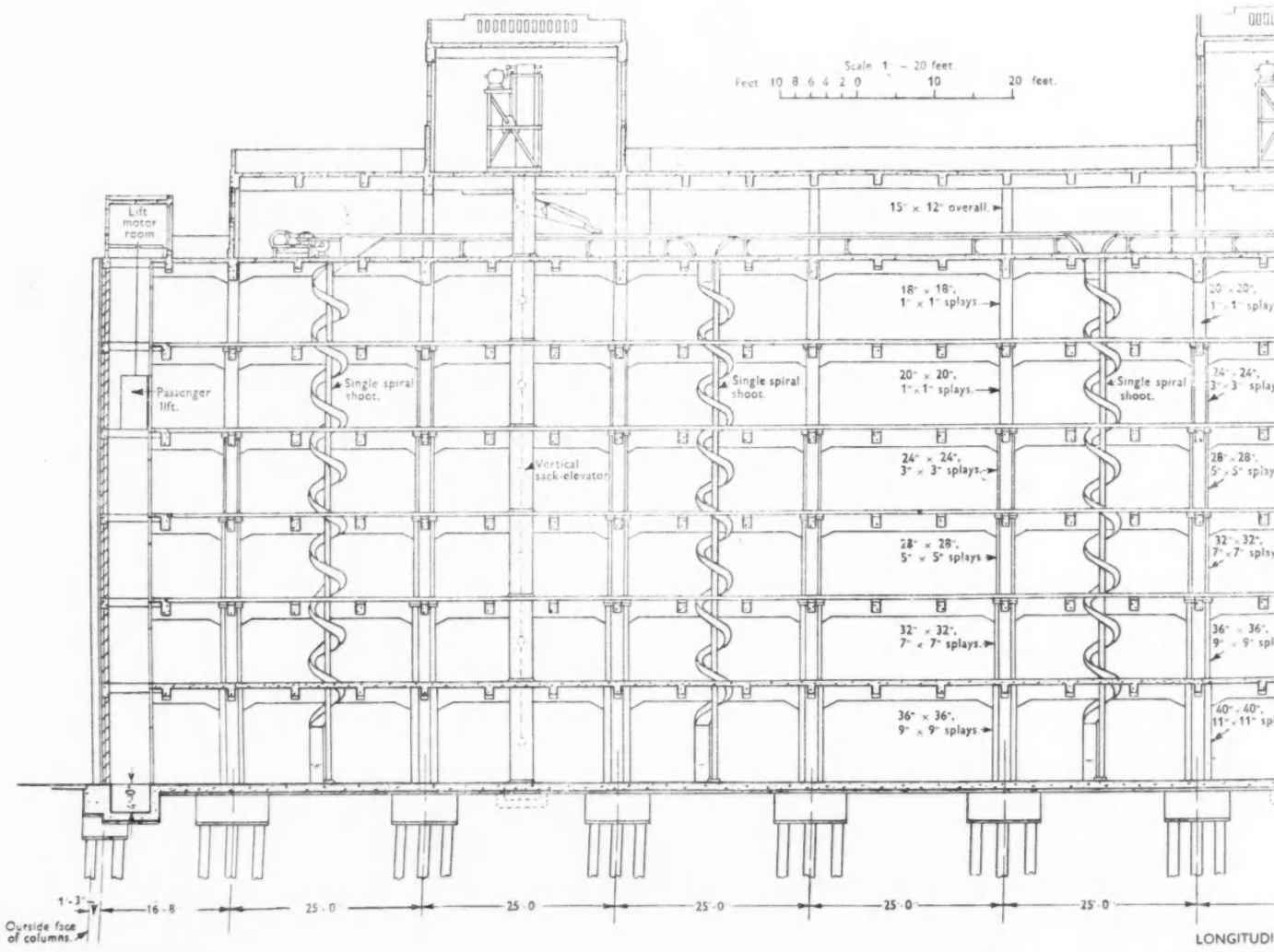
GRANARY FOR THE SOUTHERN RAILWAY.

Waterside Flour





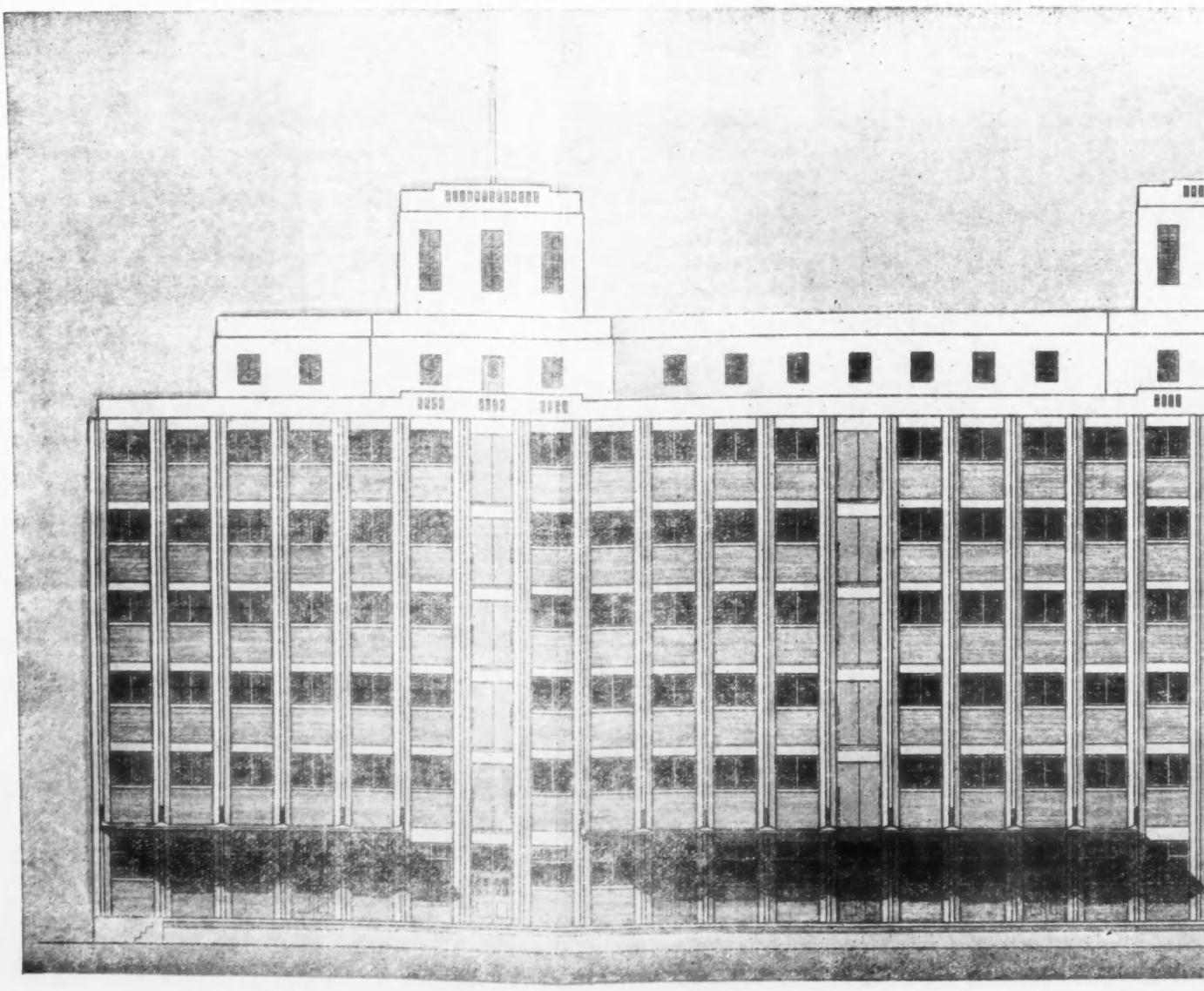
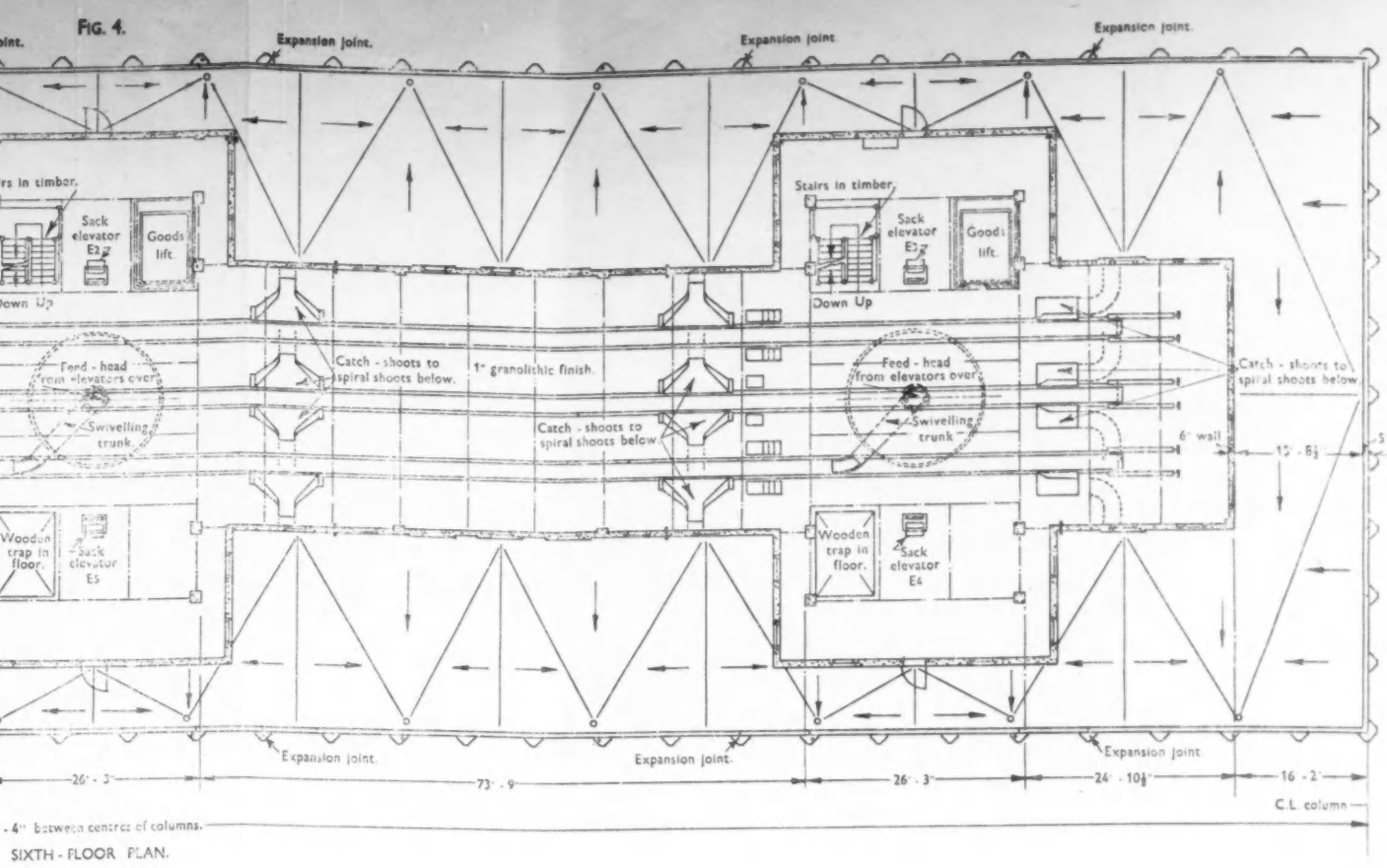


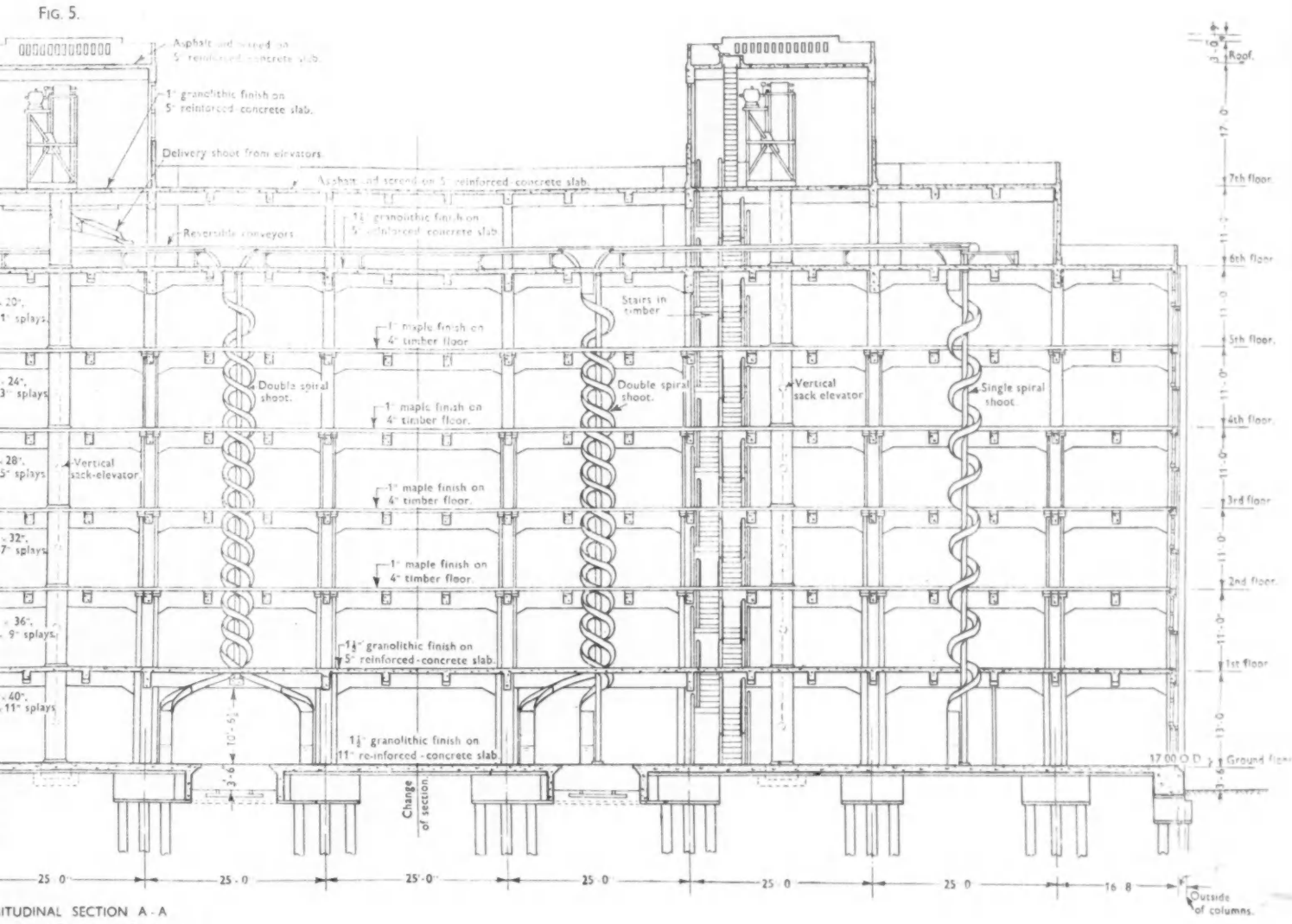
Fig. 6. No

FIG. 4.



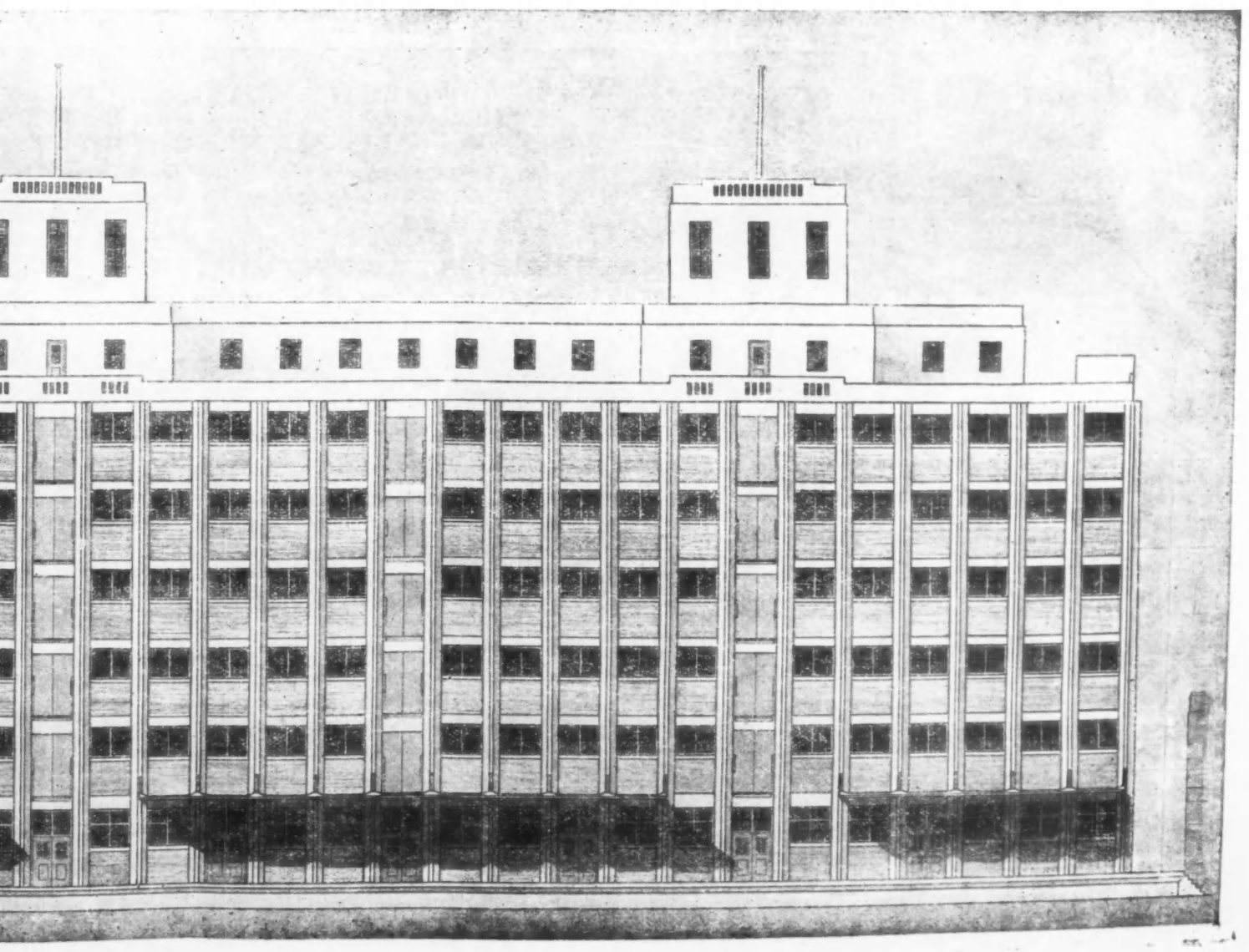
SIXTH - FLOOR PLAN.

FIG. 5.



ITUDINAL SECTION A - A

1, Plate 1, for position of section.)



North Side Elevation.

Waterside Flour and Grain Storage

*The Design of Flour Mills, Granaries, Warehouses and Silos**

By OSCAR FABER, O.B.E., D.C.L., D.Sc., M.Inst.C.E.

IN the following Paper it has been deemed desirable, for obvious reasons, to omit all place-names and other references which would give such information. Consequently the Paper must inevitably lose slightly in interest, but the Author hopes that it will still be of value.

SOUTHERN RAILWAY WAREHOUSE

The diagrams on the folder and subsequent pages illustrate a warehouse designed by the Author for the Southern Railway, with the collaboration and under the general supervision of Mr. George Ellson, O.B.E., M.Inst.C.E., Chief Engineer to the Company.

The purpose of the structure was to receive grain in sack for storage and distribution, which may be received by water or by rail, and may be delivered by rail or by lorry.

The granary, although originally intended principally for grain, has been designed also as a general warehouse to receive and store miscellaneous goods, and its handling arrangements had therefore to be more diverse than if one class of goods only were to be catered for.

The layout and general conception of the warehouse was primarily intended to effect the maximum economy in handling costs, and the equipment for handling different classes of material will perhaps be of interest.

The warehouse is approximately 310-ft. in length and 80-ft. in width, and it comprises six main storeys having an inclusive height of approximately 68-ft., measured from ground floor or platform level, which is approximately 3-ft. 6-in. above ground level.

Above the sixth floor is a conveyor gallery 280-ft. long and 32-ft. wide; the width is increased to about 64-ft. in three places to receive the tops of stairs, the goods-lift machinery and the elevator heads. Over the middle of each of these three projections is raised a tower approximately 25-ft. by 48-ft. in plan and about 17-ft. in height, so as to receive the tops of the elevator heads.

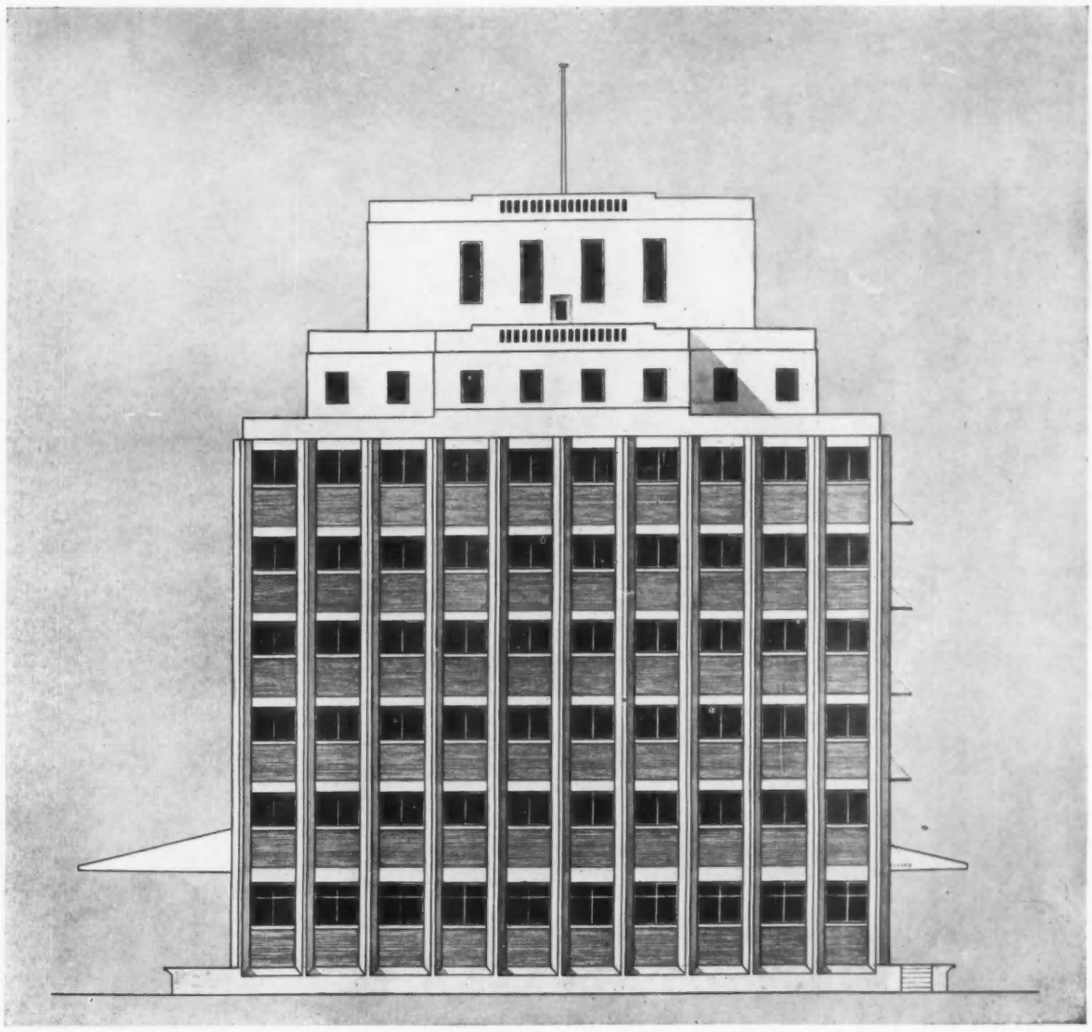


Fig. 7. East End Elevation.

Fig. 1 is a ground floor plan and shows a platform on the north side of the intake of goods, whether arriving by rail or by water.

Equipment

Goods arriving by water are handled by three large electric travelling cranes of the level luffing type, which deliver the grain in loads of about ten or eleven sacks at a time to a batch weigher on the respective platforms, of which there are also three.

A fourth crane is provided, which is primarily intended not for serving the granary, but for dealing with general goods in the yard.

From the batch weigher the sacks are delivered to three sack elevators, E.1, E.2 and E.3, on the north side of the warehouse; three similar elevators, E.4, E.5 and E.6, are provided on the south side for other similar duties.

From any of these elevators the sacks are delivered right up into one of the three towers and are tipped into a shoot having a swivelling delivery trunk which delivers to any of three reversible band conveyors in the conveyor gallery, in either direction.

*Reproduced by permission from the Journal of the Institution of Civil Engineers.

Waterside Flour and Grain Storage—continued

so that each swivelling trunk may occupy any one of six positions. This is clearly shown on Fig. 4, which is a plan of the conveyors and other gear on the sixth floor (the conveyor gallery), and in Fig. 5, a longitudinal section which shows the elevators, the conveyors and the circular shoots.

The sacks travelling along the conveyors are discharged by a board set at an angle into the top of special metal shoots which are indicated on the general floor plans, Fig. 2 and Fig. 3. Altogether there are twelve of these shoots, four of which are double spirals, whilst the remainder are single spirals, as shown on Fig. 5.

By fixing a suitable throw-off plate the sacks can be taken off at any desired floor, so that when they have been once delivered to the elevator they can, without further handling, be delivered to the nearest position of any of the twelve shoots to the point of storage on any desired floor.

Elevators are also arranged so that should sacks happen to pass on their upward journey the point where it is desired to stack them, they may be thrown out without having to employ the conveyors.

When it is desired to send the sacks away from their storage in the warehouse, they may be delivered to the ground floor direct by being sent down the shoot nearest to them; but if this would not deliver them at a convenient position near to the loading-off point (truck or lorry) they can be delivered instead to the nearest elevator and transferred by means of the conveyors to the nearest shoot, which will deliver directly to any one of six positions on either side of the warehouse (twelve in all). Thus sacks stored on the fifth floor on the north-east corner may require to be loaded off on to a lorry backed against the platform in the south-west corner. To save handling they would therefore be taken to sack elevator E.3 and delivered to the central or southernmost conveyor, from which they can be sent down the shoot at the south-west corner of the building and delivered to the loading platform.

The ground floor plan, Fig. 1, shows how the sack shoots are provided with extended throw-off shoots at the bottom so as to deliver the sacks immediately inside the doors giving on to the platforms.

The four double sack shoots will also deliver to central positions alongside the two delivery sidings which run into the building from the south side.

The method of handling described above applies only to grain and similar material delivered in sack.

Alternatively, ten or eleven sacks at a time can be delivered by the crane direct to the loading platforms outside the loading doors, shown on the north side elevation (Fig. 6), and at the side of the east end elevator (Fig. 7).

Bulky goods arriving in larger packages, or in packages unsuitable for handling in sack elevators, can be delivered direct on to any floor by the crane through the side doors previously referred to, or can be taken either up or down in the three goods lifts shown on the plans. These are approximately 6-ft. by 8-ft. inside the cage, and have a capacity of 2 tons at a speed of 100-ft. per minute.

The landing gates consist of Potter-Rax folding steel doors which close the opening with solid steel sheet, so that the lift shaft is not open to the floors and the whole shaft is enclosed with a steel partition except at the particular opening at which the lift stands. The lifts were supplied by the Express Lift Co., Ltd.

Special trolley on rubber wheels were provided to fit the lift for the more rapid and economic handling of certain classes of goods.

The conveyors and elevators were supplied by Messrs. Spencer (Melksham), Ltd.

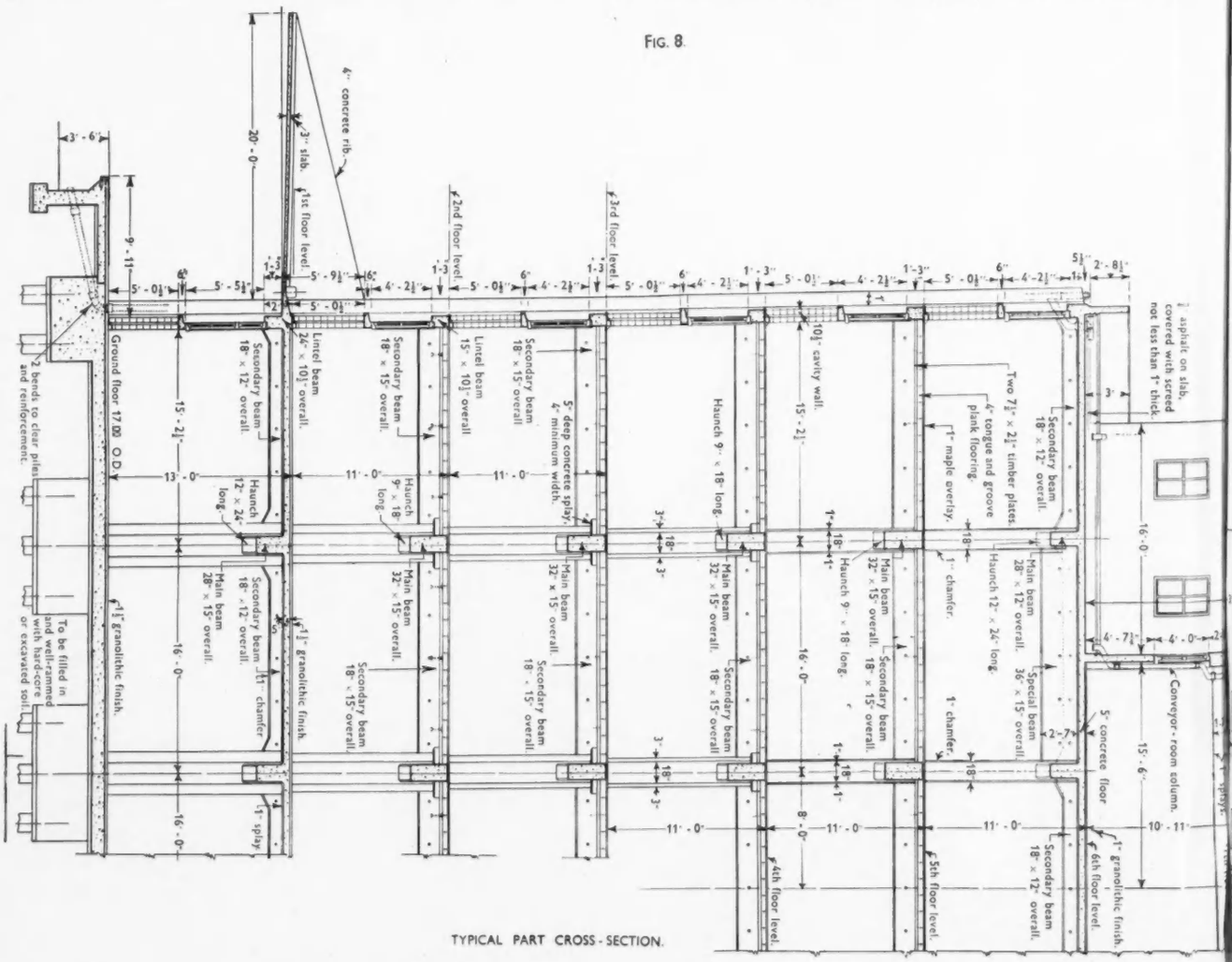
Construction

The building is a frame structure of reinforced concrete. The outer walls contain reinforced concrete piers at 8-ft. 4-in. centres at the sides and 8-ft. centres in the ends. These piers are of splayed section, as shown on the plans, so as to produce a more pleasing appearance and give external angles to 135 degrees, which experience shows are less liable to be damaged than are right angle edges. They also allow more light to enter sideways.

The down pipes from the roof are embedded inside these piers and consist of cement asbestos cast into the concrete.

The cross sectional area of each pier is approximately 3 square feet. The internal columns are at 25-ft. centres longitudinally and 16-ft. centres transversely, and are forty-eight in number. On the

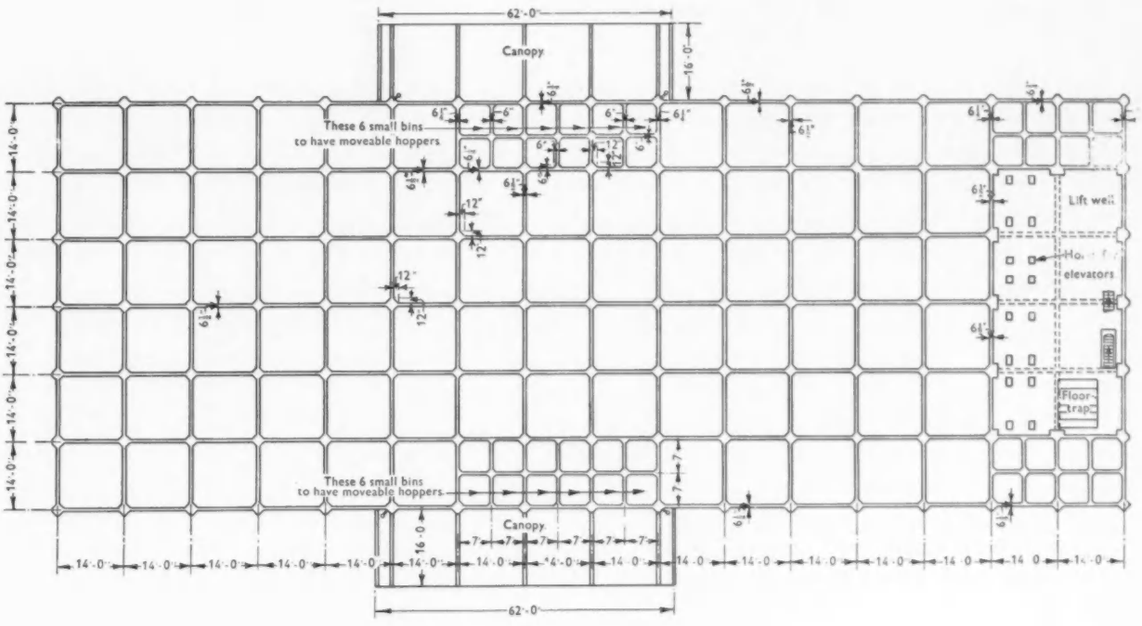
FIG. 8.



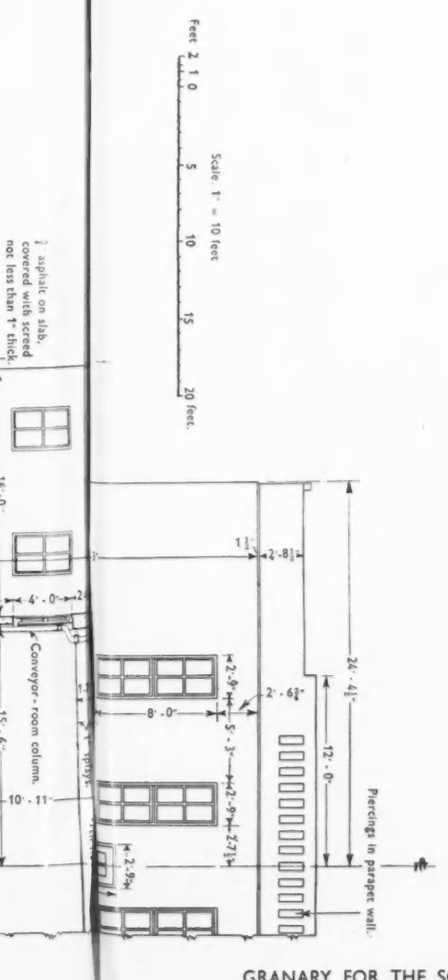
TYPICAL PART CROSS-SECTION.

Waterside Flour and Grain Storage—continued

FIG. 10



PLAN OF SILOS



GRANARY FOR THE SOUTHERN RAILWAY.

ground floor they are octagonal, 3-ft. across opposite flats under the towers and 2-ft. 8-in. in other places. These columns diminish in section as they rise, those in the top floor being 18-in. square.

The ground floor (3-ft. 6-in. above ground level) is of concrete placed directly on hardcore filling and finished with 1½-in. of granolithic. This ground floor concrete is lightly reinforced to span between pile caps, in order to prevent unequal settlement and cracking.

The first floor is of reinforced concrete 5-in. thick, finished with 1½-inch of granolithic.

The main beams, of 25-ft. span, are 28-in. by 15-in. overall under the first floor, and the secondary beams, at 8-ft. 4-in. centres, are 18-in. by 12-in. overall, haunched at the ends.

The upper floors consist of 4-in. tongued and grooved Columbian pine planks, finished on top with 1-in. maple to give a hard finish. These floors are secured to timber plates bolted to the reinforced concrete beams, which, for all floors above the first, are rectangular and not T-beams in section: the main beams are 32-in. by 15-in. and the secondary beams 18-in. by 15-in.

The ground and first floors, being of concrete finished with granolithic, are suitable for wet goods, if necessary, and can be hosed, whilst the upper floors are intended for grain and other dry goods.

The timber floors have the advantage, for this particular purpose, that they never sweat and produce mildew or other fungoid diseases in the grain or similar materials, whereas that is not always true of concrete floors, owing to their higher conductivity and specific heat.

The walls consist of 11-in cavity walls, bricks from an Essex brickyard being set in a mortar consisting of 4 parts of sand, 1 part of cement, and ½ part of lime. The two 4½-in. skins to the cavity wall are connected together by ties of stainless steel, two per square yard.

Windows extending the full way between the reinforced concrete piers, provide clear openings of approximately three-quarters the total periphery. The top of the sills is approximately 5-ft. 6-in. above floor level; there is no object in having windows below this level, as the light would be obstructed by merchandise and the upper portion of the light is the only portion which is effective.

All the window farmes are of timber, with sufficient opening on each window to enable the outsides to be cleaned without external access, and are of Columbian pine with the exception of the sills and transoms, which are of teak and of oak respectively. Contrary to usual practice, all glazing was done from the inside in order to make replacement easier.

Galvanised water bars are provided between the teak sills to the window frames and the pre-cast reinforced concrete sills on which they rest.

The 10-ft. platform on the south side is protected by a canopy projecting 20-ft. from the edge of the columns. This canopy is of reinforced concrete, with a slab 3-in. thick suspended from 4-in. ribs above, and gives a pleasantly clean effect of an uninterrupted slab on the underside. To prevent cracking, it is sub-divided by expansion joints covered by curbs and covers; the canopy is not

Waterside Flour and Grain Storage—continued

protected by asphalt or other waterproofing material, but is, nevertheless, watertight, which is possibly of interest.

On the north side the corresponding canopy has a smaller projection, as shown on the first floor plan, and is interrupted at each of the three weighbridges to enable goods to be dropped on to the platform by the cranes.

The foundations consist of 800 reinforced concrete piles 16-in. square and approximately 50-ft. long, reinforced with four 1¼-in. rods and ¼-in. links at 6-in. centres, although the spacing is much closer at the two ends of the pile.

miller who receives different kinds of grain for different purposes, can mix them in the most advantageous way.

The silos are frequently about 100-ft. high, not counting the conveyor floor at the top and the conveyor floor at the bottom.

When the length of the silo exceeds twice its diameter, most of the weight of the grain is carried on the side walls, and not on the bottom.

Arching action between the grain particles exerts lateral pressure against the walls, and this lateral pressure, multiplied by the co-efficient of friction, is sufficient to carry the grain.

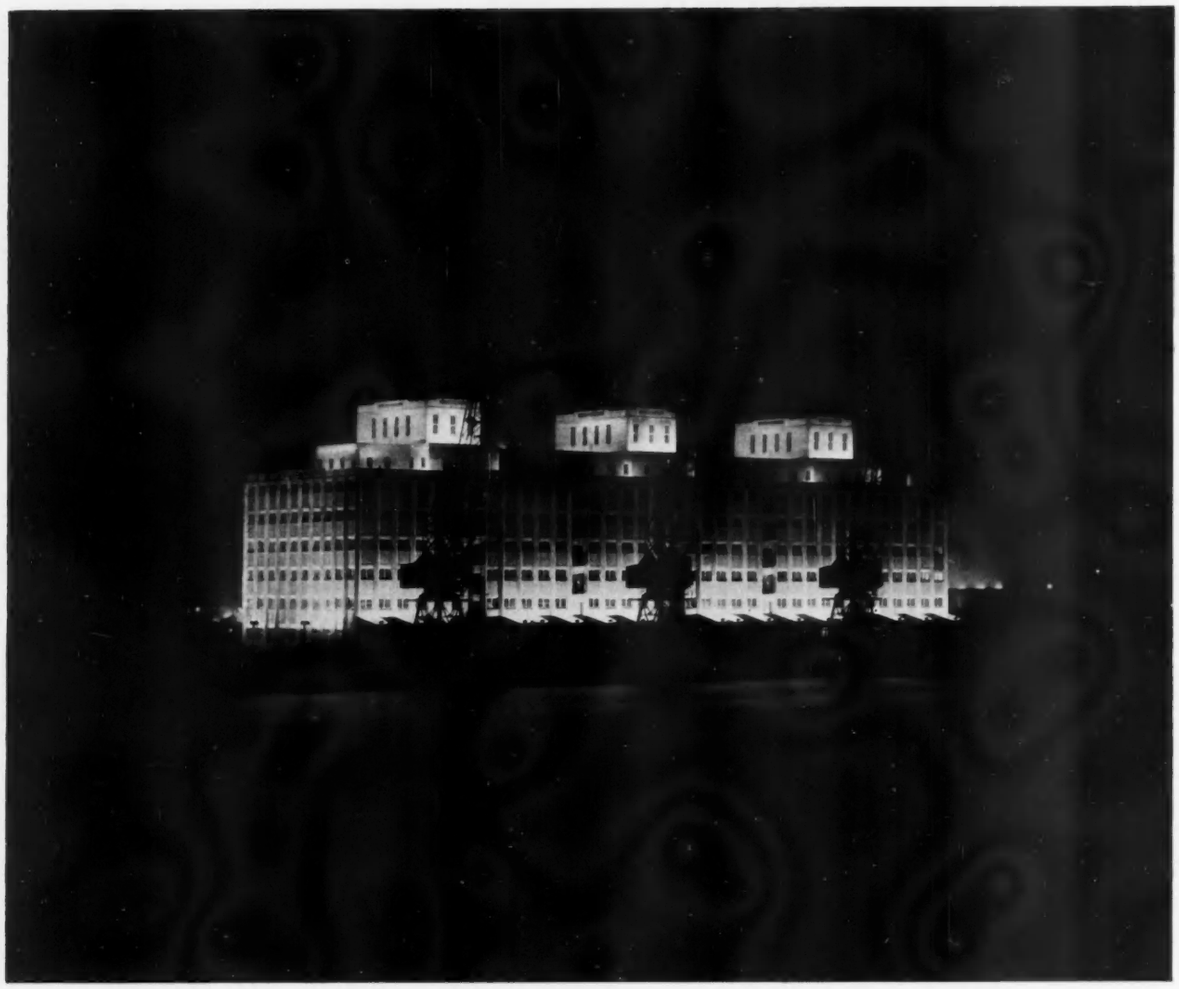


Fig. 9. The Granary.

The concrete, throughout the work, consisted of 4 cubic feet of ¾-in. shingle and 2 cubic feet of sand, with 112 lbs. of cement.

Each pile was driven by a 4-ton hammer dropping 4-ft. to a set of 120 blows per foot, and carries a load of 70 tons on the London blue clay.

Generally speaking, there were nine piles under each of the internal columns, representing a load of about 600 tons, and two under each of the external piers, representing a load of about 130 tons.

The construction is well illustrated by Fig. 8 (cross section).

Fig. 9 is a view of the building when floodlit.

Asethetic Treatment

The treatment is marked by directness and vertical rhythm of the concrete piers, whilst a warm tone is achieved by the red brick of pleasing texture in the panels.

The function of the building is expressed by the warehouse doors which give on the water side, as well as by the three large cranes, corresponding to the three elevator towers.

Additional interest is afforded by the conveyor gallery and the three towers, which serve the useful function of housing essential machinery. They break the structure up into more interesting geometrical shapes and throw interesting light and shade both by day and when floodlit by night, as in pre-war times.

GRAIN SILOS

Silos constitute the most convenient structures for storing grain in bulk in such a way that it can be quickly and economically handled and yet kept in separate consigments so that an expert

The magnitude of the pressure can be calculated by the formulas of Janssen or Airy.

Except for the uppermost two diameters, where the pressure decreases, the lateral pressure is approximately 390 lbs. per square foot for a 13-ft. 6-in. bin.

The most convenient size of bin depends upon a variety of factors. The most economical arrangement is sometimes afforded by circular bins about 20-ft. in diameter, but it must be remembered that as the size increases the pressure increases proportionally.

The circular bin provides inter-spaces between the large bins, which are not always convenient from the miller's point of view and frequently necessitate additional conveyors at top and bottom.

Construction

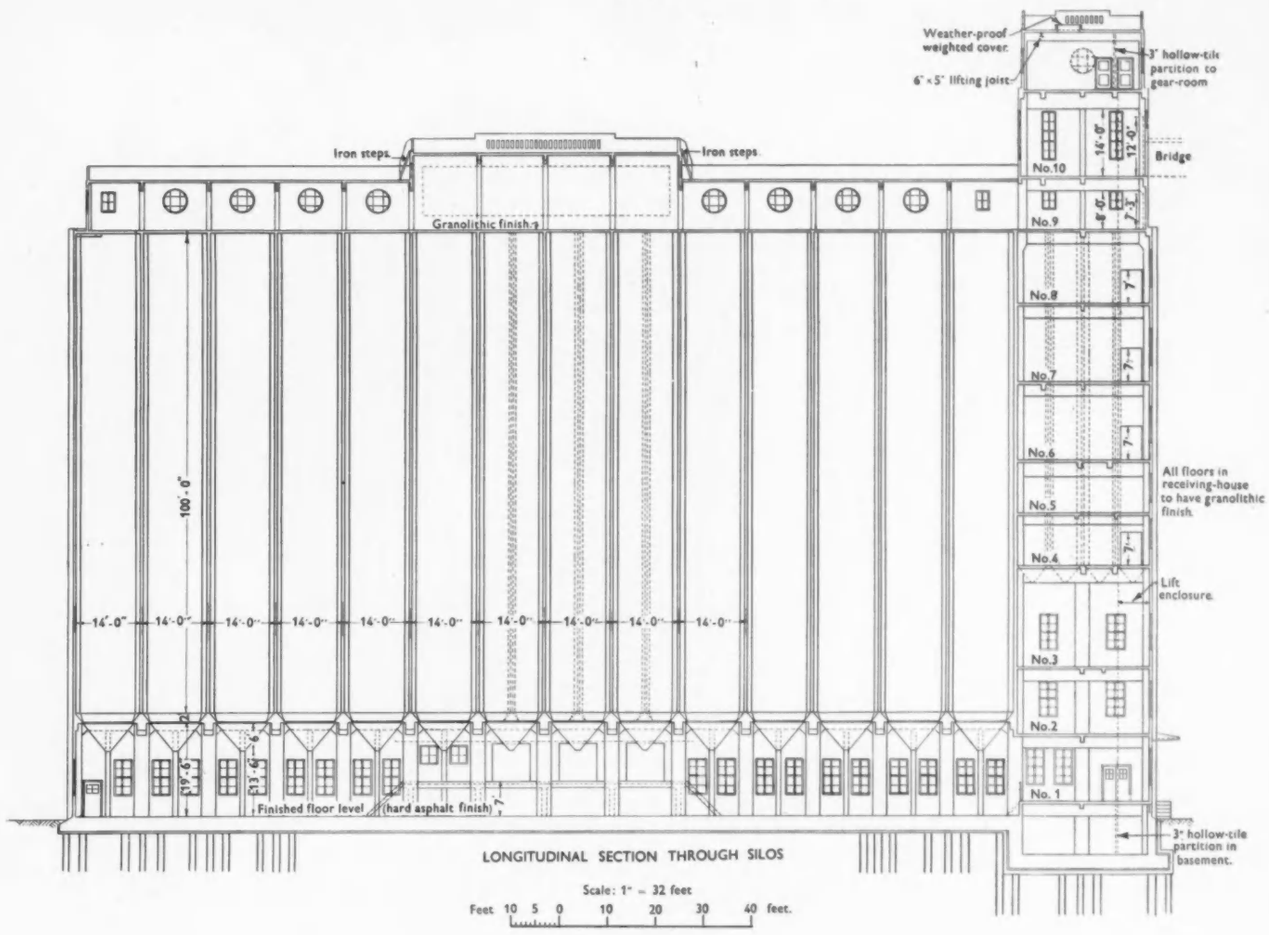
In the particular cases illustrated in this Paper, which were designed by the Author for the owners, it was found that, on the whole, the most desirable arrangement was provided by square bins at about 14-ft. centres.

The particular silo illustrated in Figs. 10 and 11 provides a block of bins 14-ft. square, sixteen bays in length and six bays in width; but at one end eight bays are devoid of bin walls and are fitted instead with floors so as to form a receiving house, wherein the elevators, weighing machines, etc., are accommodated, whilst ten of the large bins are sub-divided to provide forty small bins for handling separated small parcels of grain.

The thickness of the bin walls, except in the small bins, is 6½-in. The bottoms are generally of steel plates welded at the corners

Waterside Flour and Grain Storage—continued

FIG. 11.



MILL AND SILOS.

and suspended by an arrangement of bolts from reinforced concrete beams between the columns.

The silo is founded on reinforced concrete piles 16-in. square, carrying approximately 70 tons per pile and supporting a reinforced concrete raft 3-ft. thick which transmits the load from the columns to the piles.

An interesting feature of such silo buildings, which have now been constructed to a somewhat similar design in many places, is the method of construction.

According to this method a complete periphery of internal and external shuttering of all bin walls is provided from bin bottom level for a height of shuttering equal to approximately 4-ft. These shutters are suspended from a system of screw jacks operating on vertical steel rods which are embedded in the concrete wall and project some few feet above the level of the concrete.

When about 3-ft. 6-in. of concrete has been deposited between these shutters, all the way round, the screw jacks are operated so as to raise the internal and external shutters at a uniform speed of about 6-in. per hour while reinforcement and concrete are placed between them as they rise. With three shifts of men the silos are constructed continuously and without a break from the bottom to the top level of the silos in a period of approximately 10 days, equivalent to approximately 10-ft. of silo per day.

The speed has to be regulated so that whilst the concrete in the upper 2 or 3 feet of the shutters is plastic enough to offer little resistance to sliding, it is set as it emerges from the bottom of the shutters. For this purpose it is necessary to have complete control over the setting time of the concrete, and this can frequently be effected most conveniently by controlling the temperature, since it is well known that raising the temperature increases the speed of setting.

Most of the silos instanced were constructed in the depth of winter, and neither frost nor rain interfered with the continuity of the work, during the 10 days or so in which the 100-ft. of silos was concreted.

Arrangements were made whereby the water, sand and gravel could be warmed by steam so that the concrete emerged from the mixer at a temperature of approximately 60 degrees F., even during a severe frost, but this temperature could be varied up or down to control the setting time.

This method of construction is extremely economical when the silos have a height which justifies the mechanism required. Probably nothing less than 50-ft. would justify it.

In favourable cases, however, it may well have the effect of reducing the cost of the shuttering in normal times from about six shillings per yard to about two shillings per yard.

Treatment

The treatment is illustrated by Fig. 12 (left-hand building). It will be seen that the receiving house is carried up to a tower at one end, which serves the useful function of housing lift machinery, elevator heads, etc., and is provided with several setbacks, whereby its clumsiness is relieved and an additional sense of grace and stability is afforded.

The function of the building is clearly indicated by carrying the bin walls through to form external piers, whereby a pronounced vertical treatment and a sense of rhythm are afforded, whilst the fenestration of the top and bottom floors indicates the only places where work is done, in contrast to the intermediate portions where bulk storage is provided.

Surface Finish

Special care was taken with the surface finish of the concrete, without the application of any false covering coating.

Concrete surfaces can be very unpleasant to the eye when little care is taken with them. Sometimes the board marks show in an irregular manner indicative of lack of foresight. Sometimes air boles are filled by rubbing over with slurry or mortar which generally dries a different colour (and frequently an unpleasant one) from the main surface, and leaves a patchy result. In the case described the surface was rubbed over with wooden floats while the concrete was still soft, without the addition of anything other than water. In this way, slight ridges were reduced and filled in to any air holes without the application of additional material of differing composition, so that no change in colour was effected.

When the work reached the top, the whole surface was rubbed down with carborundum blocks, working downwards, whereby a smooth finished face of a light colour, somewhat resembling Portland stone, was achieved at a very low cost. Even when sliding shuttering is not used, a similar effect can be obtained by striking the shuttering at the earliest moment and applying the treatment already described.

(To be continued)

Bluff Harbour Board, New Zealand

Excerpts from the Annual Report for the Year ended 30th September, 1940

Income and Expenditure.—Summarised, this account shows the following:—

	£
Income	41365
Ordinary Expenditure	39604
	1761
Less Depreciation	8387
Nett loss, being debit balance on the year's working ...	£6626

The balance for the year 1939 was a credit of £7,200.

The statement of the Board's wasting assets which accompanies the Balance Sheet shows the amount of depreciation which has been written off the various assets, leaving them at what is considered a reasonable value.

In the Revenue Account the two main items are Wharfage Dues and Ships' Charges. For the past year Wharfage Dues amounted to £24,843 as against £28,051 in 1939, a decrease of £3,208 or 11.43 per cent. Ships' Charges brought in £12,265 as against £19,133 for the previous year, a decrease of £6,868 or 35.89 per cent.

The Balance Sheet shows that there is an excess of Assets over Liabilities of £115,870.

The Board's Financial Position.—Since 1937 a surplus of Cash Assets over Loan Indebtedness and Cash Liabilities has replaced what was known as the nett debt of the Board. At 30th September, 1940, this surplus stood at £5,910 as against £6,495 in 1939. This is a decrease of £585 accounted for as follows:—

	£	£
Reduction in Fund Account		4024
Increase in Contractors' Deposits and outstanding coupons		7
		4031
Less Loan Instalments paid off	1500	
Sinking Fund payments and interest on S. Funds ...	318	
Difference in Sundry Creditors	397	
Difference in Sundry Debtors	1221	
Difference in Accrued Interest	10	
		3446
		£585

Trade.—The tonnage of cargo handled through the Port of Bluff for the 12 months ended 31st December, 1940, was:—

Imports	58147
Exports	109129
Total	167276

The figures for the same period in 1939 were:—

Imports	83295
Exports	86853
Total	170148

This shows a decrease compared with the previous year, of 25,148 tons imported and an increase of 22,276 tons exported, or a total cargo decrease of 2,872 tons.

Shipping.—The number of vessels which have worked cargo to Bluff for the year ended 30th September, 1940, was:—

Coastal	354
Overseas and Inter-Colonial	73
Total	427

Compared with previous years the numbers were:—

	Coastal	Overseas and Inter-Colonial	Total
1937	395	120	515
1938	372	128	500
1939	396	119	515

Harbour Improvements.—In my address last year I mentioned that the Board's officers were preparing a further report on the question of dredging and when this came before the Board in April last together with the Secretary's Financial Report for the first six months of the financial year, the Board felt it its bounden duty on account of the shoal patches revealed by recent soundings, and also in view of the heavy overhaul of the Dredge that had been incurred, to adopt the recommendations of the report and continue dredging as indicated. The position was reviewed from time to time and at the end of September last the Dredge was sent for annual overhaul in readiness for a dredging programme in 1941. The Dredge, after years of service, required a costly overhaul, but on account of the renewals carried out she should be capable of efficient service for some years.

It is imperative that the depth of water in the fairway and the swinging basin be maintained as ships drawing more water are using the Port, and at the present time we are getting more and more final port ships which mean deep draughts. Full details of the work carried out and the areas dredged will be found in the Engineer's Annual Report.

Canals and Inland Waterways

Central Committee Appointed

The Minister of War Transport has set up a Central Canal Committee, which will meet under the chairmanship of the Parliamentary Secretary, Col. J. J. Llewellin, M.P., to advise him on questions of policy affecting inland waterways and to co-ordinate the work of six Regional Canal Committees. This is one of the steps recommended by Mr. Frank Pick, who has recently carried out, on behalf of the Minister, an investigation into the possibilities of making more effective use of the canals and inland waterways of the country.

The Central Canal Committee, which held its first meeting on Friday, September 12th, is constituted as follows:—

Col. the Rt. Hon. J. J. Llewellin, C.B.E., M.C., T.D., M.P. (Chairman), Parliamentary Secretary, Ministry of War Transport.
R. B. Emley, Esq., C.M.G., Chairman, N.E. Regional Canal Committee.
R. Davidson, Esq., M.Inst.T., Chairman, N.W. Regional Canal Committee.
Lt.-Col. F. Rayner, D.S.O., T.D., Chairman, E.M. Regional Canal Committee.
P. Nadin, Esq., Chairman, W.M. Regional Canal Committee.
A. C. Lisle, Esq., Chairman, S.W. Regional Canal Committee.
S. R. Hobday, Esq., O.B.E., M.Inst.T., Chairman, London Regional Canal Committee.
M. Kissane, Esq., representing the Canal Association.
Col. Forrester Clayton, D.L., J.P., M.Inst.T., representing Canal Carriers.
J. Ironmonger, Esq., representing Canal Carriers.
J. O. Wood, Esq., representing Canal Carriers.
J. Walley, Esq., Ministry of Labour and National Service.
D. W. Milford, Esq., Transport and General Workers' Union.

The Ministry representatives on the Committee are Mr. R. H. Hill, C.B., Deputy Director-General (Inland Transport), and Mr. S. W. Nelson. The Secretary is Mr. E. R. Batten.

Reconstitution of Regional Committees

Following Mr. Pick's recommendations, the six existing Regional Canal Committees have been reconstituted and strengthened with a view to providing an effective supervisory machinery composed of those already skilled and knowledgeable in the canals and canal traffic of the Region to ensure that the canals and canal facilities are worked as a unit and that their resources as a whole are utilised to the greatest advantage. The Regional Committees include representatives of other forms of transport and of Government Departments in addition to canal members. Their main functions are to organise effective operation of the canals and the full and efficient working of craft; to survey traffic possibilities and to make sure that traffic conveniently water-borne is allocated as far as practicable to the canals; to minimise empty running and to ensure that carriers keep their craft manned and in repair, arranging if necessary for the pooling of craft and investigating unreasonable delays; to see that maintenance and dredging are properly carried out, and to arrange for the loan of plant, equipment or staff for the purpose.

Mr. Pick also recommended the establishment of minimum guaranteed wages for canal workers with a view to the protection of the industry from loss of labour to other industries. Negotiations conducted through the Regional Committees have already resulted in agreement in most Regions.

Additional Recommendations

Other recommendations made to the Minister by Mr. Pick are being acted upon. Among them may be mentioned:—

The examination and revision, where necessary, of tolls, rates and charges.

The simplification and extension of the Government subsidy paid on transit tolls with a view to the attraction and retention of canal traffic.

The provision of warehouses, transit sheds and terminal facilities in consultation with the Ministries of Food and Supply; many schemes are in preparation and some have been started.

The provision of mobile cranes, mechanical handling equipment and boat engines with assistance from Government funds.

The undertaking of a survey of traffic with a view to the allocation of suitable blocks of traffic to the canals; a coal traffic survey has already been carried out in consultation with the Mines Department with the result that a 15 per cent. increase in canal-borne coal has already been achieved.

The encouragement of consolidation of the canals and single undertakings within the various Regions; negotiations will take some time but should result in improving and consolidating the position of the canal industry.

The abandonment as far as practicable of those canals which have no useful traffic purpose.

An Early Australian Pier

A photograph of considerable historical interest is reproduced on this page from a block kindly lent us by *The Locomotive*, with the esteemed concurrence of *Modern Transport*, in a recent issue of which it appeared. It represents an early pier scene at what is now Port Melbourne, but was a century ago called Sandridge. Distant some 2½ miles from the City of Melbourne in the Australian State of Victoria, it was linked with it by a short broad-gauge line, the Melbourne and Hobson's Bay Railway, opened in 1854.

The photograph shows the wooden-decked pier, with the rail tracks laid upon it and a small locomotive, called the " Pier Donkey," engaged in shunting operations. A number of clipper sailing ships, together with an old-fashioned, square-rigged steamer, are moored alongside the pier, the deck of which is cumbered with goods discharged therefrom, as well as with travellers arriving or departing by rail.

It was in 1835 that John Fawkner sailed up the River Yarra in his little vessel *Enterprise*, laden with material for the first settlement in the district. By 1841, so rapidly had colonisation proceeded, the population of Melbourne was 11,000, and when, in 1851, gold was discovered in the neighbouring State of New South Wales, the number increased in a very few years to over 100,000. The present population is more than a million.

An early scene at Sandridge Pier Terminus of the Melbourne and Hobson's Bay Railway, the first public line in Australia, opened in 1854.

The little locomotive shown in the picture was a four-wheeled well-tank engine with cylinders and motion arranged on the lines of an old American " inside-connected " design, rather than those of the traditional British inside-cylinder type.

National Dock Labour Corporation

Announcement of Registration

National Dock Labour Corporation, Ltd., has now been registered as a company limited by guarantee without share capital. The objects are stated as follows: " To act as a central or national organisation for promoting the rapid handling of goods and turn-round of ships in United Kingdom ports, and in particular by establishing or facilitating the establishment of an adequate, regular and mobile labour force and for the regular employment of port transport workers.

The Corporation is registered with 24 members, but the directors may register an increase from time to time. Each member is liable for not more than £1 in the event of winding up.

The subscribers of the Corporation are: Messrs. Arthur Deakin, acting general secretary, Transport House, Smith Square, S.W.1; David W. Large, acting secretary, London Docks Group, Transport and General Workers' Union, 218, Green Lanes, N.; Daniel W. Milford, Transport House, S.W.1, national secretary; J. D. Ritchie, Port of London Authority, Trinity Square, E.C., general manager; J. K. Swire, 28, Cornhill, E.C.3, shipowner; Chas. Cullen (National Council of Port Labour Employers), Port of London Authority Buildings, E.C.3; Stanley Sparkes, 15, Trinity Square, E.C.3, director; and Wm. Moore Turner (general secretary, National Amalgamated Stevedores and Dockers), 653, Commercial Road, E.14.

The board is to consist of a chairman, a financial director and no fewer than four, nor more than six other directors. The chairman and financial directors are to be appointed by the Minister of Labour and National Service (in the case of the chairman, after consultation with the National Joint Council for Dock Labour). The solicitors are: Messrs. Parker, Garrett and Co., St. Michael's Rectory, Cornhill, E.C.3.

Publications Received

The Institution of Structural Engineers have issued a **Report on Buildings Damaged by Air Raids** and Notes Relative to Reconstruction (price 6d.; 11, Upper Belgrave Street, S.W.1), which affords useful information on the subject, limited only by the necessity of not publishing anything likely to be useful to the enemy. For this reason, reference to names and positions of individual buildings and to the size and nature of the bombs which caused destruction, have been omitted. Within the compact limit of seven pages there are a number of serviceable recommendations for structures to be erected in the future.

The **Journal** (1940-1941) of the **Engineering Society,** of University College, London, now temporarily installed at University College, Swansea, constitutes an interesting record of the activities of the Society in its new environment. It contains some interesting technical and general articles, agreeably mingled with student persiflage. Among the lighter sketches is an account of " The Epic Journey of Phineas." Phineas, it may be recalled, at one time enjoyed considerable notoriety in the Press. He is the wooden effigy of a stalwart Highlander, which, to the best of our recollection, originally occupied a prominent position on the doorstep of a trading concern in Tottenham Court Road. He became the bone of contention between the students of King's College in the Strand and of University College, Gower Street. A number of pubilc scrimmages took place for his capture and recapture. We now learn that he has taken up residence in Swansea, where perhaps he may be free from molestation.

The **British Engineers' Association** (32, Victoria Street, S.W.1), with creditable enterprise, have replaced the first print of 5,500 copies of their **Classified Index of Members** and their Manufactures (1941 edition) which was destroyed by enemy action, and have issued new copies for circulation in quarters where the information contained is likely to be useful. The publication consists of some 450 pages of addresses of firms and announcements of their manufactures, arranged both alphabetically and in trade classification. Dock and harbour engineers will find convenient directorial aid in such matters as cranes, dredgers, excavators, dock-gate operating machinery and the like among their more general requirements in machinery and plant. We are asked to state that on receipt of a written request made to the Association on a business letter heading, copies of the Index will be sent free and post free to applicants who could make good use of them.

The 23rd Annual Harbours and Waterways Edition of *Shipping Register and North American Ports* is adequately described on the cover as " featuring shipbuilding in Canada," containing, as it does, a number of articles on the activities at Canadian shipyards. In addition there are interesting and informative descriptions of some of the leading ports of Canada, though detailed particulars which might be of assistance to the Axis powers are necessarily withheld.

The recent remarkable development of shipbuilding enterprise in the Dominion is shown by the following extract from the Foreword to the well illustrated brochure of 56 pages.

" There is presently a total of approximately 30,000 workers engaged in shipbuilding in Canada as compared with 4,000 two years ago. Orders from Canadian and British Governments have been placed with Canadian shipyards during the past year for many ships—mostly naval. Included in these orders were 20 merchant vessels, but recently announcement was made that the merchant shipping programme had been increased to 96 ships of 10,000 tons each. Thus, in addition to naval contracts for corvettes, mine sweepers and other war craft which have been, and will continue to be, placed with some 200 yards, large and small, there is close to a million tons of mercantile shipping to be constructed, with promise of further business when that has been completed. It is estimated that, by 1943, shipbuilding, on hand or in prospect, will call for the employment of between 40,000 and 50,000 men."

The Publisher, Mr. H. R. Pickens (610, St. James Street, Montreal, Que.), who contributed the article on Harbours and Waterways of Canada, is to be complimented on an attractive and useful compilation.

Notable Port Personalities

XV.—Mr. John Wilson

Mr. John Wilson, the present General Manager and Secretary of the Clyde Navigation Trust, was born in 1892, and was trained for the legal profession. He commenced his business career as a solicitor on the staff of the Solicitor (Scotland) of the London, Midland and Scottish Railway. He then became Clerk and Solicitor to the Commissioners for the Harbour and Docks of Leith.

Mr. JOHN WILSON.

In 1932 he entered the service of the Clyde Navigation Trust as Assistant to Mr. James Macfarlane, at that time General Manager and Secretary, succeeding him in the position in 1935. Mr. Wilson is also Secretary to the Clyde Pilotage Authority.

He served in the War of 1914-18 with the Argyll and Sutherland Highlanders and with the Rifle Brigade, being wounded at St. Quentin in March, 1918.

Otago Harbour Board, New Zealand

Chairman's Annual Report for the Year ended September 30th, 1940

The following report has been addressed to the members of the Otago Harbour Board, New Zealand, by Mr. John B. Waters, Chairman:—

In the previous year the figures for cargo, shipping and revenue, in spite of import restrictions, were remarkably good. During the year under review we have been suffering from the full impact of import restrictions, and to a lesser degree from war conditions, and the result is evident in our Statement of Receipts which, after excluding receipts in connection with the hire of the Dredge "Otakou," show a reduction of some £26,000 as compared with 1938-39. During the current year it is highly probable that we must expect a further decline, and with this in prospect it behoves the Board to walk very carefully in all matters of expenditure.

Trade and Shipping

The total tonnage of cargo handled through the Port was 431,977 tons, a decrease of 44,920 tons, or just under 9½ per cent. on last year's tonnage.

Imports declined by nearly 40,000 tons, or 12 per cent., which was not surprising in view of all the circumstances. The total exports also decreased by just over 5,000 tons, equal to 3½ per cent. on last year. The overseas shipments fell by nearly 14,000 tons; wool and fruit accounting for over 12,000 tons of this decrease. Intercolonial and coastal shipments on the other hand have increased by 8,500 tons.

The tonnage of shipping arrivals at 860,562 tons (net) fell considerably below that of last year (1,059,195 tons), the decline being 198,633 tons, or equal to 19 per cent. Although coastal tonnage increased by 6,000 tons (3 per cent.) there were substantial decreases in overseas and intercolonial shipping, the figures being 147,000 tons (21 per cent) and 57,000 tons (41 per cent.) respectively.

Revenue and Expenditure

The decrease in trade and shipping is naturally reflected in the receipts for the year. These were, on a comparative basis, some £26,000 below those for 1938-39. Unfortunately, owing to this shrinkage it was impossible to make the usual transfer to the Tug Renewal Fund.

The Income and Expenditure Account shows that, after providing for interest, exchange, sinking fund contributions, loan repayments and depreciation of plant, there is an excess expenditure over income of £13,544. It is to be regretted that our revenue shows a decline of £22,219, but this is caused by circumstances over which the Board has absolutely no control. Expenditure, which is not easily reducible, is only £3,157 less than the previous year.

Works Programme

The contract for two 5-ton "Arrol" Cranes for George Street Pier is held up indefinitely owing to war conditions. On the other hand, the timber for flush-decking the north side of the pier is now in hand, and if the Board so decides this work can be undertaken as soon as the export season finishes. The provision of accommodation for the waterside workers at Port Chalmers is also a matter of urgency and this is now under consideration. These works, if decided upon, together with the reclamation of a further portion of the South Endowment area, and repairs to the Cross Wharf and Bowen Pier, will fully occupy the engineering staff during the current year.

Works Completed

The conversion of the dredge from an oil to a coal burner under the supervision of Mr. W. L. Coxhead was carried out by the Board's staff most satisfactorily, and the operation of the dredge as a coal burner has been both efficient and economical.

The Birch Street Wharf was completed in February, 1940, and the widening of the Leith Canal from Forth Street Bridge to the harbour in June of the same year. Extensive repairs were also carried out at Kitchener Street Wharf, the Rattray Street Wharf and the Port Chalmers Docks.

An embankment was constructed round a 35-acre area on the South Endowment preparatory to a resumption of reclamation, and a roadway was formed through the block of land on the Western side of the Leith Canal with a view to making this land available for leasing.

Conclusion

The foregoing paragraphs give a general outline of the principal activities of the Board for the year ending September 30th, 1940. In addition, special interest has been taken in wharf protection under war conditions, in the establishment of a Harbour Area Committee under the Emergency Precautions Scheme, in afforestation and irrigation, and in co-operating with the City of Dunedin in setting up a Council for the purpose of promoting industrial developments on the reclamation area.

It is with much pleasure that I record that, in spite of many adverse conditions, the work of the Board has been carried on during the past year with the greatest harmony. For this I express my sincere thanks to Board Members, the Executive Officers and the staff in general, and although we have still to face strenuous days we confidently rely on the same spirit of cheerful co-operation in carrying on the work of the Port in the interests of the Province and of the City.

The foregoing is accompanied by Reports from the Secretary and Treasurer, the Engineer and the Harbour Master, and by a detailed statement of accounts.

Removal of Wrecks in Harbour Waters

Under date of August 20th, the Minister of War Transport has issued an Order relaxing any obligation upon dock or harbour undertakings to announce publicly their intention with regard to the removal of wrecks, etc., before proceeding with operations. The relevant paragraphs of the Order, which is cited as "The Dock and Harbour Undertakings (Control of Wrecks and Other Obstructions) Order, 1941," are as follows:—

"1. Every power conferred upon a Dock or Harbour Undertaking over vessels sunk, stranded or abandoned, or over any other wreck or obstruction or danger to navigation or over any property recovered therefrom including every right to recover from any person all or any of the expenses incurred in dealing therewith, shall be exercised by that undertaking without publication of the exercise or intended exercise of that power and without the necessity for obtaining the consent of any other person; and the obligations or limitations imposed with respect to that undertaking by or by virtue of any Act or other instrument determining the functions of the undertakers shall be relaxed accordingly.

"2. In this Order the expression 'vessel' shall include every article or thing or collection of things being or forming part of the tackle equipments cargo stores or ballast of a vessel."

New 500-ton Slipway at Puerto Cabello, Venezuela

In connection with a new naval base which is being installed at Puerto Cabello (an old port and one of the early points of settlement in the new world) the Venezuelan Government has recently installed a 500-ton slipway.

This new naval base is part of Venezuela's comprehensive programme for national betterment.

Vessel being floated on to cradle.

In 1937, ship repairing equipment at the yard was limited to a single 180-ft. by 80-ft. section of an originally two-section composite floating dock. Toward the latter part of 1937, the Venezuelan Ministry of War engaged the Crandall Dry Dock Engineers, Inc., of Cambridge, Mass., U.S.A., to report concerning the present facilities and probable future requirements.

Early in 1939, the Ministry of Public Works, acting for the Ministry of War, engaged the same firm as consulting engineers to prepare plans and specifications for new shops, quay walls and a 5,000 to 6,000 ton floating dry dock; also to design and construct a 500-ton slipway.

The first item in the dockyard development programme was the 500-ton slipway dock. This dock was completed in February, 1940. Its site, in a land-locked harbour, ideally free from large

Vessel on cradle.

waves and ground swell, is just north of the original yard on recently reclaimed land of sufficient area to permit considerable future expansion. The installation consists of a cradle which travels on a system of free rollers over a two-way track, the gradient of which is an arc of a vertical circle. The principal dimensions and general description follow:

Slipway Dimensions

	Metres
Length over keel blocks	40.00
Length overall	43.50
Width over cross-beams	11.50
Width clear	9.50
Length of track	112.00
Depth of water over keel blocks, forward ...	2.50
Depth of water over keel block, aft	4.00

The Cradle

The cradle is built of structural steel throughout, except for the deck, docking platform and blocking. Its under-body consists of two vertical and parallel runners, to the under-side of which are riveted steel rail plates. Beams carrying the keel and bilge blocks, as well as the deck, are framed transversely over the runners. This deck, or working platform, covers the entire length of the cradle, full width, and extends beyond the keel blocks at the after-end to facilitate repairs to propellers and rudders. On both sides of the cradle are docking platforms supported by steel uprights fastened to the transverse beams. From these docking platforms, vessels are centred and blocked through the use of hand winches which operate the seven sliding blocks on each side of the cradle.

Tracks

The tracks are the two-way type, 112 metres long, constructed on an arc of a circle, so that the cradle is horizontal when in the upper or "hauled-up" position. The inshore portion of the track, above low water, is of reinforced concrete, while the outshore, or submerged portion, is of wood, protected against marine borers. Both sections are supported on long timber piling driven deeply into coral, dense sand and silt to a firm bearing.

Vessel withdrawn from water.

After these piles were driven, they were cut off, under water, along the line of proper curvature. Meanwhile the wood track was constructed as a unit ashore, floated over the piles, sunk in place, carefully aligned, and then fastened permanently by the diver.

The cradle moves over this track on a system of free rollers of alloy steel. The lower surfaces of the cradle runners and the upper ones of the track are equipped with flat steel plates between which these rollers operate. By this means the friction is minimised and there is no need of lubrication.

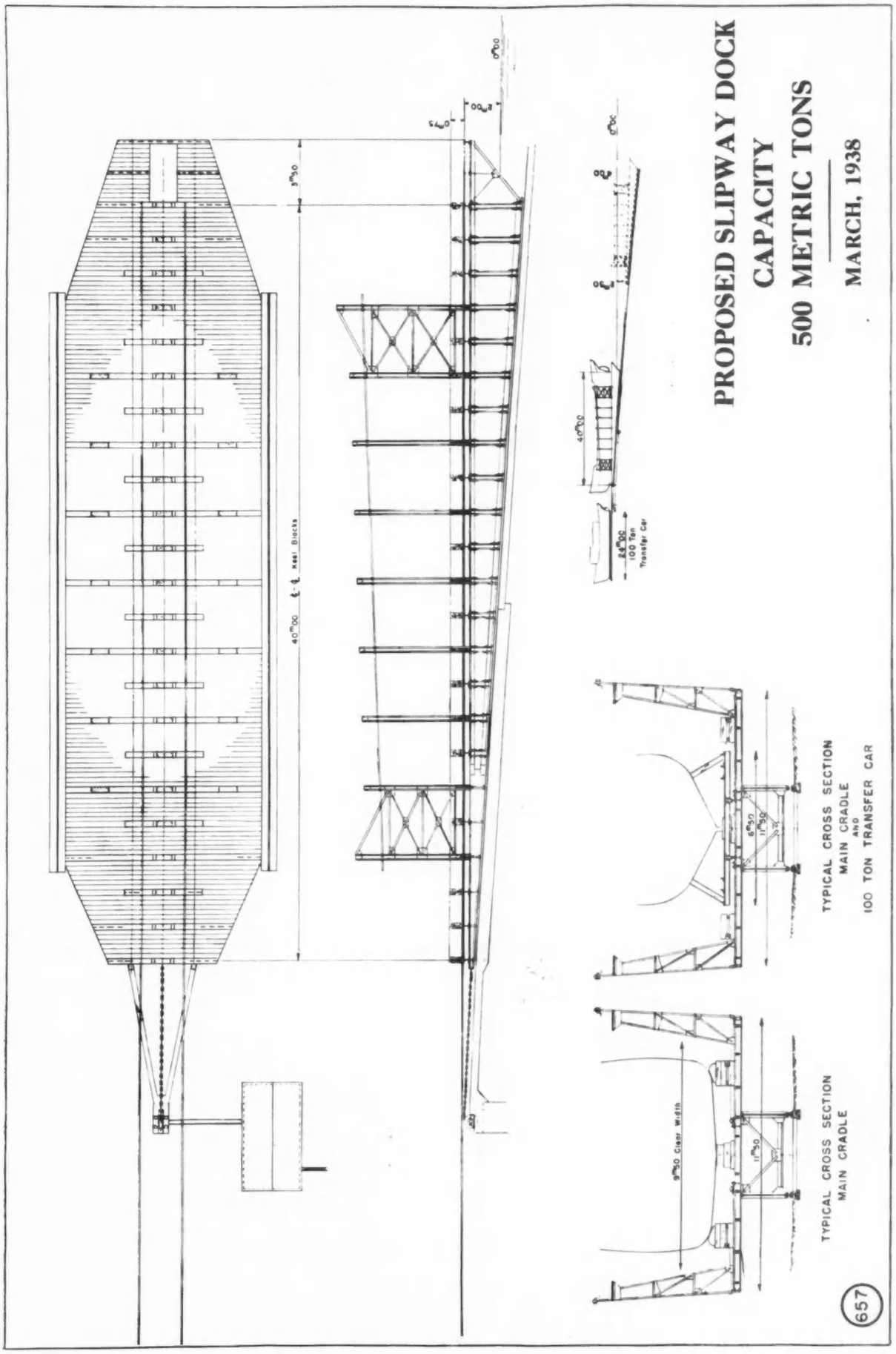
Hauling Mechanism

The cradle is operated by a single hauling chain arranged on an endless system, operated by an electric hauling machine, sufficiently powerful to haul a capacity load in about 15 minutes. The hauling chain, of heat-treated, manganese steel, without welds, passes over a toothed sprocket wheel on the main shaft and then back along the track, where the lower end is attached to a smaller backing chain. This backing chain passes through a submerged sheave and returns on itself with the other end fastened to the cradle. The machinery has two speeds; high for hauling less than capacity loads; low for capacity loads.

Auxiliary Cradle and Storage Tracks

When in its upper position the cradle is horizontal as has been pointed out. Along the top of the cradle are longitudinal rails, making it possible to dry dock and haul ashore to temporary storage, on an auxiliary cradle, small vessels weighing up to 100 tons. This transfer cradle is mounted on wheels and moves along the rails on top of the main cradle to an adjoining system of tracks ashore at the head of the railway dry dock. Thus two or more ships may be served simultaneously; while the transfer cradle is on the storage track; the main cradle is an independent unit.

New Slipway at Puerto Cabello, Venezuela

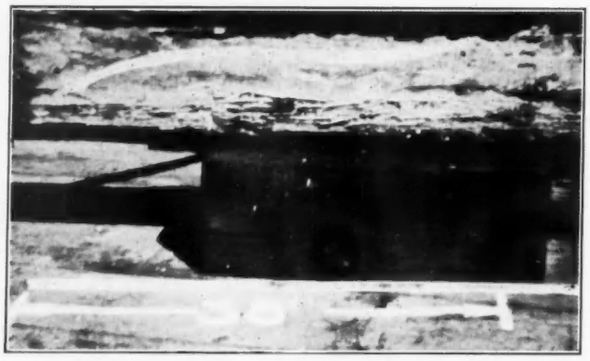


Timber Pile Preservation

Antidote to Attack by Marine Organisms

By T. H. HANSEN.

THE January and February issues for this year of *World Ports* (the organ of the American Association of Port Authorities) contain a couple of articles by Mr. T. H. Hansen descriptive of a method of treatment for timber piles in sea water known as the Toxic Refill Method. The information contained in these articles, relating to tests on piles in Trinidad waters, is of considerable interest, and, as it may be serviceable to readers of this Journal, a description of the treat- and its effects is given hereunder.



The Teredo lines its burrow with a tube of white lime.

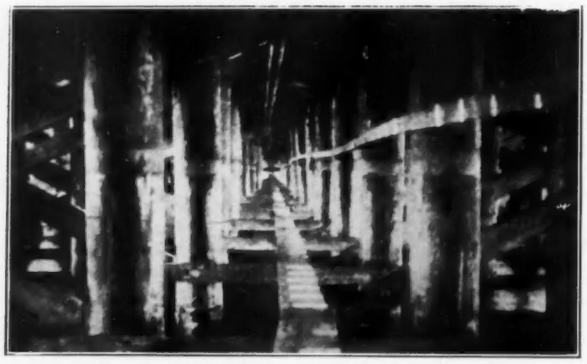
After premising that the task of providing adequate protection for existing (pile) structures is engaging the close attention of scientists, pier owners and engineers throughout the world, and that innumerable experiments have been carried out with new products and new methods, Mr. Hansen goes on to say:

The most recent of these new methods is the Toxic Refill. It is claimed that it is a practical method of providing economical, dependable and enduring protection for creosoted piles. The length of time a creosoted pile is immune from marine borer attack varies in different localities.

Depredations in Trinidad

During the last 20 years the deterioration and the destruction of marine structures on the Atlantic seaboard, the Gulf and South American Coast has assumed gigantic proportions. The heavy attack on treated piles in Trinidad, British West Indies, is rather severe. Records show that 18 to 20 lb. treated piles only last from 6 to 8 years. One example is the Brighton Main Pier, built in 1927, which contained 400 18 lb. treated piles. The condition of these piles as reported by the engineer was as follows:

In October, 1930: 17 piles ¾ gone; 5 piles ½ gone; 4 piles ¼ gone.
In March, 1932: 60 piles ¾ gone; 28 piles ½ gone; 32 piles ¼ gone.



The Toxic Refill applied to 600 piles, 80 to 90-ft. long.

An oil company pier, built in 1927 with 14 lb. treated piles in this vicinity, was completely destroyed by borers in 3 years and had to be condemned in 1930. A new pier was built in 1930 with 18 lb. treated piles. During 1936, 10 per cent. of the piles had to be replaced. In 1937, the pier was in such a bad condition that something had to be done quickly to prevent the pier from collapsing.

The real foes of the piles in Trinidad waters are the *Martesia*, *Limnoria* and *Teredo*, named in the order in which they attack a chemically treated pile.

The *Martesia* are known to be active southwards from Charleston, South Carolina. This clam-like borer seems to be less affected by toxic elements than any other borer. It does not mind boring into a treated pile provided it has lost some of its toxic oiliness. *Martesia* first attack a 20 lb. treated pile when the pile is 2 or 3 years old. This attack starts in the tidal range, because toxic influence is first withdrawn from this area by the suction of tide and waves. *Martesia* increase yearly, so that at the end of 4 years, the protective shell of treated sapwood is partially destroyed in the tidal area. The attack extends down to the mudline, diminishing considerably from low tide downwards.

The *Limnoria Lignorum*, also known as the *Gribble*, resembles the termite or woodlouse. This tiny animal does the most destruction in these parts. They first attack treated piles after the *Martesia* has already gained a strong foothold on the pile. They require that the pile lose more of the toxic contained in the shell of the pile before they can comfortably start to nibble away on the outer surface of the pile. *Limnoria* are so numerous that one square inch may contain 100 or more. By rapidly destroying the surface layers, they expose the untreated part of the pile. Their attack is easily visible. They usually start in the tidal range and their offspring attack the pile down to the mudline.

The damage by the worm-like *Teredo* is considerably less than that occasioned by the *Martesia* and *Limnoria*. It cunningly avoids attacking a chemically treated pile until it is damaged by handling, by other borers, or by withdrawal of the deadly toxic. Entering the pile through a hole no larger than a pin hole, the pile may be honeycombed before the attack of this insidious borer is noticeable. As many as 100 million eggs have been counted in one Teredo and 100 entrances have been counted in one foot of heavily attacked piling. Due to their rapid growth they can destroy the untreated part of the pile when it is exposed faster than the other two named borers. They operate by drilling holes and a full grown Teredo may be 1-in. in diameter and 4 to 6-ft. long.

The Toxic Refill causes the pile to sweat and the lethal concentration on the surface is sufficient to prevent marine borers from attaching.

Investigations confirm the important observation made on many chemically treated piles pulled out after years of service, that the attack below low water is usually only half as much as between high water and low water.

In pier construction, treated piles are preferred when protection against borers is required. It offers excellent protection as long as the dissolving and chemical effect of sea water does not reduce the concentration below the lethal toxicity.

A new treated pile placed under a pier is subjected to a withdrawal of its chemical elements by action of sea water. This can be clearly seen by the difference in colour of sections cut out of pulled piles. Tests have shown that the lighter fractions containing the vital constituents are particularly toxic to the borers. The heavier or pitchy matter, which remains in the pile, is known to be very much less toxic and does not offer much protection. If this were not so the borer would have started his attack on the pile immediately. The very fact that the chemicals protected the pile for a considerable time and then failed is sufficient proof that the toxic fractions have been removed. The loss of the chemicals is as high as 75 per cent. in 4 years, according to a test made on piles cut out of the Naval Pier at St. Thomas. Naturally, the loss is greatest in the tidal range. In Trinidad the loss is considerable in the tidal area to wave and tidal action. During the greater part of the year water splashes around the pile in a washing machine like action.

Action of Toxic Refill

This situation is overcome by the Toxic Refill, which provides a continuous supply of the deadly toxic for the sapwood shell of

Timber Pile Preservation—continued

the pile. Where borers have already attacked the pile the installation of this method preserves the piles and the borers gradually diminish in numbers and die out completely. This fact is proved by the inspection of 600 piles.

The sapwood shell of the pine pile (*Alburnum*) contains the tube-like cells called *Tracheids*. During the life of the tree, large volumes of water had to be rushed through the tracheids to supply the growing buds, branch tips and leaves with moisture.

In the Toxic Refill, the liquid toxic is forced to travel down the tracheids and fill the sapwood shell to a depth of one inch or more from the point of refill to below the mudline. This extra heavy saturation of the sapwood shell spreads and provides the surface of the pile exposed to the sea water with a continuous supply of the toxic.

As already stated, the *Limnoria* is the most dangerous and destructive borer in this vicinity and attacks piles with greatest intensity in the tidal area. One of the most important facts established by the inspection of the Brighton Pier is that only 6 out of 538 piles were attacked by *Limnoria*. This was of recent origin and only small patches of about one square foot were affected. This attack was due to driftwood damaging the protective device. When remedied, the *Limnoria* were exterminated.

A good example of the merits of the Toxic Refill is the Brighton Pier Extension built in 1931. At the same time a 37-pile dolphin of the same grade of treated piles was completed in close proximity to the pier. The Toxic Refill was applied to the pier and not to the dolphin. In 1936, the dolphin piles had to be renewed because they were eaten through by marine borers. To date not one pile has been replaced in the Pier Extension.

The comparative cost of a pier with and without the protection afforded by the Toxic Refill is amply illustrated by the following report made in 1939:

A pile to pile inspection of the original pier was made in October and November, 1939, when the old pier was 4 years old, showed 209, or 39 per cent. of the piles to be 75 to 100 per cent. destroyed at the water line—120 or 20 per cent. of the piles were approximately 50 per cent. destroyed and the remainder were reported as anything from 15 to 30 per cent. destroyed at the water line. Four months after this inspection the pier was destroyed by fire. An inspection of the piles after the fire confirmed the pile inspection report and there is no doubt but it would have been necessary to replace approximately 100 each year until all had been renewed.

The cost of these replacements plus other necessary repairs would have amounted to not less than $100,000 in total, an average of $20,000 per year. On that basis the total cost of the pier, including original cost, plus repairs and replacements at the end of 9 years, would have been approximately $250,000. The present pier has cost a total, including original cost, plus repairs, replacements, cost of Toxic Refill and construction of new breasting and corner dolphins of $152,148 in 8 years. Adding $6,400 estimated for repairs in 1940, the total cost of the present pier for 9 years of service will be approximately $158,500, or $90,000 less than the original pier for a like period of years.

This is an average saving of $10,000 per year and fully justifies the installation of the Toxic Refill. This report indicates that the yearly saving will gradually increase to $20,000 per year within the next 9 years.

Martesia Shell Fragments After Treatment.

From left to right 1, 2 and 3 as described below.

1. Taken from a chemically treated pile from area 3-ft. below M.L.T. 2. Taken from a chemically treated pile which had 3 months of Toxic Refill treatment from area 8-ft. below M.L.T. 3. Treatment about 5 months, fragment taken from 7-ft. below M.L.T.

It must be remembered that in tropical waters marine borers are much more abundant and active than in northern waters; therefore the results achieved by this method in the ten years of application are most outstanding.

Extermination Tests

In order to gather more information concerning the efficacy of the Toxic Refill Method, 15 piles selected at random, were given an accelerated test for the purpose of determining how long it takes to exterminate the borers living within the piles. Treatments were increased and periodical inspections of specific areas of the piles were made at 1 to 3 month intervals.

The diving gang was made up of 1 foreman, 3 divers and 2 helpers. Two divers took turns scraping barnacles off the piles. A diver especially trained for marine borer observation made the inspection of all the piles. The results were further checked by Mr. Hansen who went down in the diving outfit and checked the reports at frequent intervals during the inspections. Since the jackets extend to 2-ft. below mean low tide and 3 to 15-ft. of the pile below the jacket was scraped clean completely around the pile, a very good conception of the condition of the piles was obtained. Furthermore, some of the piles were cleaned at different levels down to the mudline. No borers were found on any piles below 15-ft. M.L.T.

Mr. Hansen relates that many interesting observations were made during the underwater inspection of the piles. A scene of weird beauty presents itself when looking around under water: the piles seem like a forest of branchless trees, rising out of the mist and there is a feeling that here is something worth while to protect against the savage onslaught of the treacherous marine borers. Small fish similar to Sheepshead are nibbling on the piles which are covered with marine growth. They come very close but when reaching out to get hold of one, they move away quickly. Schools of sardine-like fish swim around in great numbers. Often when investigating empty *Martesia* holes, tiny crabs suddenly dart out and scurry away.

Chemically treated pile partially destroyed by Martesia.

Drifting near the piles, an object about the size of a half-a-dollar was caught, which proved to be a small octopus. It probably lost its home when large clusters of barnacles were scraped off the pile.

Another oddity encountered was a small fish about the size of a quarter, which had a line, curled at the end, attached to the top fin. It appeared as if the fish had a line and hook out.

After scraping off the barnacles, Mr. Hansen noted that about 20 per cent. of the piles had small strips of the skin pulled off. It must be mentioned that these piles were shipped to Trinidad, unloaded and rehandled before driving. Even when taking the greatest care in handling, some abrasion of the protective shell is unavoidable. Usually the first sign of borer attach on such damaged piles was in the crevices where the skin of the pile was stripped off. Piles with small knot holes were also found in the area inspected. None of these holes contained any live borers.

For a summary of the pile inspections see table No. 1.

Interesting facts disclosed in table No. 1 are:

1. All borers exterminated on 11 piles.

2. Ninety-five per cent. or more of the borers exterminated on 4 piles.

3. The remaining borers will gradually die out since no sign of a new attack can be found on any test pile.

In order to make table No. 1 more easily understood, details of test pile No. 2 are listed below.

Test No. 2:

December 15th: Start test after cleaning and inspecting 3-ft. of pile below the jacket.; 58 holes and 40 live borers were counted in this area.

March 12th: Test period about 3 months. Cleaned 4-ft. of pile. No live borers and 15 dead shells were found in this area.

May 16th: Test period about 5 months. Cleaned 10-ft. of pile. No live borer and 4 dead shell found in 4-ft.; 12 live borer and no dead shell found in 4 to 8-ft. No live borer and six deal shell found in 8 to 10-ft.

The pile was very smooth from 8½-ft. below the jacket on down, no sign of previous borer attack could be observed.

At 7-ft. below mean low tide fragments of dead *Martesia* shells were picked out of the pile by the diver. They were completely discoloured and almost black on the outside. At 8½-ft. below M.L.T. dead shells were picked out of the pile. The tip of these shells were not discoloured, but the big end of the *Martesia* shell was heavily discoloured by the Toxic Refill treatment.

June 5th: Test period about 6 months. Cleaned 8-ft. of pile. No live borer and 4 dead shells found in 4-ft. No live borer and no dead shells found in 4 to 8-ft.

Test completed in about 6 months.

In addition to the Marine Borer Extermination Test, 70 piles were inspected before and after 8 months of regular treatment. In this case Table No. 2 gives the result of this interesting test.

Timber Pile Preservation—continued

Table No. 2. Summary of Second Pile Inspection

Total number of piles, 70	100%
Piles with all borer exterminated, 27...	39%
Piles with less live borers, 40 ...	57%
Piles with same amount of borers, 3	4%

No piles were found that had signs of a new borer attack, or with an increased borer count.

Both tests prove that the most aggressive *Martesia*, known to be able to withstand more usual chemical treatment than any other marine borer, can be exterminated on any part of the pile down to the mudline within a certain time limit.

By exterminating the *Martesia*, which is considered the toughest of all marine borers, we put a stop to all other borers. The delicate and less defensible veligers of the *Limnoria* and *Teredo* have no chance to attach themselves to or live in the Toxic Refill treated shell of the pile.

The facts revealed in these tests prove that the Toxic Refill provides the pile with a surface which cannot be attacked or destroyed by marine borers.

It is a well-known fact that if chemically treated piles are not destroyed by marine borers that part of the pile from high water mark on down will last practically indefinitely.

Therefore, it can safely be assumed that piles treated by this method will last twice or many times longer than piles without this method.

One of the points most difficult to understand, remarks Mr. Hansen, is how the toxic can penetrate into wood which is thoroughly water-soaked. The question, " How can the toxic be induced to travel 40 to 50-ft. from the cap to the mud line? " is answered completely by the tests and service records contained in this article.

Inspections and tests prove that the toxic in the pile starts exterminating the marine borers 5-ft. below mean low tide in about 6 weeks. This is proved by a count of dead *Martesia*, as indicated in the table, Test No. 5. Out of 120 live borers only 60 live ones were counted after 6 weeks.

Since the point of refill is about 9-ft. above M.L.T. this treatment is effective 14-ft. below the point of refill in 6 weeks.

In view of the variable density of pine, the great difference in the *Tracheids*, the twisting grain of the wood at the knots, the bulges and the flats of the trunk of the tree, Mr. Hansen considers the results achieved in the tests extraordinary.

To obtain the best results, he says, it is important to preserve the chemically treated sapwood shell of the pile, because of advantages that the flow of the toxic be uninterrupted. He strongly recommends that the Toxic Refill be installed on such treated piles before, or at the first indication of borer attack in ports which are infested by marine borers.

In conclusion, he points out that the protection of piles in existing piers involves peculiarities of location, design, and construction, for which certain allowances must be made in order that the best and lowest cost installation be made for a given location.

TABLE — MARINE BORER EXTERMINATION TEST.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Test number															
Bent number	16	17	20	25	26	26	28	32	32	33	33	33	35	37	40
Pile number	6	6	1	6	2	6	5	1	2	2	LB	5	6	1	5
Martesia holes	50	58	98	30	120	24	72	70	50	50	58	60	14	37	43
Live B. in 3 ft.	28	40	47	22	120	14	48	42	28	30	36	45	5	22	26
Start test month	2	12	2	10	12	10	12	1	1	1	1	12	9	12	11
Period months	1½	3	1½	3	1½	3	3	2	2	2	2	3	3	3½	2
Lin. ft. inspected	4	4	4	3	3	3	4	4	4	5	4	4	3	4	4
Live B. found	18	0	7	0	60	0	0	6	24	27	30	2	0	7	0
Period months	3	5	3	*	3	*	4½	3½	3½	3½	3½	4½	*	5	4
Lin. ft. inspected	4	4	4	*	4	*	9	10	9	11	8	10	*	8	10
Live B. found	0	0	0	*	20	*	0	6	19	8	12	8	*	11	7
Period months	3	5	3	7	4½	7	*	5	5	5	5	6	8	6	5½
Lin. ft. inspected	10	10	10	8	8	8	*	11	10	8½	8	9½	8	10	12
Live B. found	8	12	16	0	31	0	*	0	15	4	7	0	0	15	0
Period months	4	6	4	*	6	*	*	*	6	6	6	*	*	7½	*
Lin. ft. inspected	8	8	12	*	9½	*	*	*	10	9	9	*	*	10	*
Live B. found	0	0	4	*	16	*	*	*	15	0	0	*	*	9	*
Period months	*	*	5	*	9	*	*	*	8	*	*	*	*	9½	*
Lin. ft. inspected	*	*	14	*	14	*	*	*	15	*	*	*	*	10	*
Live B. found	*	*	7	*	7	*	*	*	13	*	*	*	*	8	*
Total months	4	6	5	7	9	7	4½	5	8	6	6	6	8	9½	5½

Remarks—Start of test Sept. 4, 1939. Test completed Sept. 10, 1940.

Areas inspected are measured from below the jacket, which extends to 2 ft. below M.L.T. Point of application is 9 ft. above M.L.T. All piles were inspected down to the final depth where the pile appeared like new. No attack below this point by borers could be observed in the final check during the last inspection. The borers referred to are *Martesia*. No other type of borer could be found on these test piles.

*Denotes test discontinued and regular treatment resumed.

New Diesel-Electric Dredgers for the United States

A contract has been placed by the United States War Department for the construction of two twin-screw Diesel-electric hopper dredgers. The vessels will be of a new fast shallow-draught type, 216-ft. in length, and capable of carrying 700 cubic yards of material, without drawing more than 12-ft., at a speed of 13 knots; the first is to be delivered in December, and the second six months later, and the contract price is about three million dollars. The engine and motor room will be situated aft, and a single 16-in. electrically-driven pump will be installed forward. When the pump is idle the whole of the output of the main generators can be concentrated on the propulsion motors, making possible the loaded speed of 13 knots and a light vessel speed of 16 knots. The craft will have a beam of 40-ft. and a breadth outside sponsons of 53-ft., and a depth of 15½-ft. The prime movers will consist of two 650 b.h.p. Diesel-driven generators so connected that the power output may be either divided between the 350 h.p. dredge pump motor and the gear-reduction type 475 b.h.p. d.c. propelling motors, or thrown entirely on the latter, as dredging routine requires. About a year ago the Pusey and Jones Corporation, of Wilmington, Delaware, with whom the contract has been placed, delivered the 300-ft. all-diesel seagoing hopper dredger *Chester Harding* to the United States Engineer Department, New York.

Retirement of Canal Superintendent.

Mr. T. Rylance Hague, Superintendent of the Bridgwater Canals undertaking, has retired after 53 years' service therewith, and with the Manchester Ship Canal Company.

Obituary.

The death has been announced of **Mr. Kai L. Mygind,** at East Wretham, Norfolk. He had been joint governing director (with Mr. H. P. T. Lind), of Messrs. Peter Lind and Co., Ltd., building and civil engineering designers and contractors, Stratton House, Stratton Street, London, W.1, since the formation of the company.

New Floating Dock for Vancouver.

A new floating dock of 10,000 tons lifting capacity is to be constructed immediately, at an estimated cost of 780,000 dollars, for the harbour of North Vancouver, Canada. The dock has been rendered necessary by the award of a contract for 15 cargo vessels, each of 9,300 tons, to North Vancouver Repairs, Inc.

Argentine Port Traffic.

The Report for the twelve months ended May last of the Centro de Navegacion Transatlantica, of Buenos Aires, states that the transatlantic maritime traffic to and from Argentine ports has decreased in respect of passengers and import and export trade to an extent so considerable as to be unprecedented in the official records of the past fifty years.

South African Harbour Finances.

Statistics issued by South African Railways and Harbours show that revenue from the Administration's harbour undertakings for the twelve months ended March 21st last showed a surplus of £505,534, steamships a surplus of £43,518, and airways a deficit of £75,784. Revenue from the harbours in April last amounted to £199,524, showing a surplus over expenditure of £35,414. The figures for the corresponding month last year were £205,137 revenue, and £68,202 surplus. Revenue from steamships was £25,896 (£1,373 surplus), against £4,013 (£511 surplus). Revenue from airways was nil, £2,756 deficit), against £9,764 revenue (£11,302 deficit).

Buyers' Guide for Dock and Harbour Authorities

For Particulars of Space in this Guide apply to the Manager, "The Dock and Harbour Authority," 19, Harcourt Street, London, W.1.

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BOILERS.

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